Federal Register

Wednesday,
October 25, 2000

Part II

Department of Transportation

Federal Aviation Administration

14 CFR Parts 413, 415, and 417
Licensing and Safety Requirements for Launch; Notice of Proposed Rulemaking; Proposed Rule

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 413, 415, and 417

[Docket No. FAA–2000 ; Notice No. 00–10]

RIN 2120–AG37

Licensing and Safety Requirements for Launch

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: The Associate Administrator for Commercial Space Transportation of the Federal Aviation Administration (FAA), Department of Transportation (DOT), is proposing to amend the FAA's commercial space transportation regulations. The FAA proposes to amend its regulations to codify its license application process for launch from a non-federal launch site. A non-federal launch site is a launch site not located on a federal launch range. The proposed regulations are also intended to codify the safety requirements for launch operators regarding license requirements, criteria, and responsibilities in order to protect the public from the hazards of launch for launch from a federal launch range or a non-federal launch site.

DATES: Send your comments on or before February 22, 2001.

ADDRESSES: Address your comments to the Docket Management System, U.S. Department of Transportation, Room Plaza 401, 400 Seventh Street, SW., Washington, DC 20590–0001. You must identify the docket number FAA–2000–7953 at the beginning of your comments, and you should submit two copies of your comments. If you wish to receive confirmation that FAA received your comments, include a self-addressed, stamped postcard. You may submit and review comments through the Internet at http://dms.dot.gov. You may review the public docket containing comments to these proposed regulations in person in the Dockets Office between 9:00 a.m. and 5:00 p.m., Monday through Friday, except Federal holidays. The Dockets Office is on the plaza level of the NASSIF Building at the Department of Transportation at the above address.

FOR FURTHER INFORMATION CONTACT: Michael Dook, Licensing and Safety Division (AST–200), Associate Administrator for Commercial Space Transportation, Federal Aviation Administration, DOT, Room 331, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267–8462; or Laura Montgomery, Office of the Chief Counsel (AGC–200), Federal Aviation Administration, DOT, Room 915, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267–3150.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of the proposed action by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this document also are invited. Substantive comments should be accompanied by cost estimates. Comments must identify the regulatory docket or notice number and be submitted in duplicate to the DOT Rules Docket address specified above.

All comments received, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking, will be filed in the docket. The docket is available for public inspection before and after the comment closing date.

The Administrator will consider all comments received on or before the closing date before taking action on this proposed rulemaking. Late-filed comments will be considered to the extent practicable, and consistent with statutory deadlines. The proposals in this document may be changed in light of the comments received.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this document must include a pre-addressed, stamped postcard with those comments on which the following statement is made: ''Comments to Docket No. FAA–2000–7953.'' The postcard will be date stamped and mailed to the commenter.

Availability of Rulemaking Documents

You can get an electronic copy using the Internet by taking the following steps:

(1) Go to the search function of the Department of Transportation's electronic Docket Management System (DMS) Web page (http://dms.dot.gov/search).

(2) On the search page type in the last four digits of the Docket number shown at the beginning of this notice. Click on ''search.''

(3) On the next page, which contains the Docket summary information for the Docket you selected, click on the document number of the item you wish to view.

You can also get an electronic copy using the Internet through FAA's web page at http://www.faa.gov/avr/arm/nprm/nprm.htm or the **Federal Register's** web page at http://www.access.gpo.gov/su_docs/aces/aces140.html.

You can also get a copy by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267–9680. Make sure to identify the docket number, notice number, or amendment number of this rulemaking.

I. Introduction

By this notice of proposed rulemaking, the FAA proposes licensing and safety requirements for the conduct of a launch. The proposed requirements for obtaining a license would apply to a launch operator planning to launch from a non-federal launch site. A non-federal launch site is a launch site that is not located at a federal launch range. The proposed regulations for obtaining a license would not, however, apply to any launch from a non-federal launch site where a federal launch range performs the safety functions. For such a launch, the licensing requirements of 14 CFR part 415, subpart C applies. The proposed regulations are also intended to codify the safety requirements that a launch operator must satisfy to protect the public from the hazards of launch. The safety requirements contained in this proposed regulation apply to all licensed launches of expendable launch vehicles whether from a federal launch range or a non-federal launch site. This notice provides information regarding the criteria for obtaining a launch license, the responsibilities with which a launch licensee must comply, and operational requirements.

II. Background

The Commercial Space Launch Act of 1984, as codified and amended at 49 U.S.C. Subtitle IX—Commercial Space Transportation, ch. 701, Commercial Space Launch Activities, 49 U.S.C. 70101–70121 (the Act), authorizes the Department of Transportation and thus the FAA, through delegations,[1] to oversee, license and regulate commercial launch and reentry activities and the operation of launch and reentry sites as carried out by U.S. citizens or within the United States. 49 U.S.C. 70104, 70105. The Act directs the FAA to exercise this responsibility consistent with public health and safety,

[1] See Commercial Space Transportation Licensing Regulations, 64 FR 19586 (Apr. 21, 1999).

safety of property, and the national security and foreign policy interests of the United States. 49 U.S.C. 70105. The FAA is also responsible for encouraging, facilitating and promoting commercial space launches by the private sector. 49 U.S.C. 70103. A 1996 National Space Policy recognizes the Department of Transportation as the lead federal agency for regulatory guidance regarding commercial space transportation activities.

The FAA licenses commercial launches, the subject of this notice of proposed rulemaking in accordance with the Act and 14 CFR Ch. III. Until recently, all commercial launches took place under the cognizance of federal launch range safety organizations, which impose comprehensive safety requirements on launch operators. The FAA has been able to rely significantly on the safety oversight activities of the federal launch ranges. Consequently, many safety issues did not need to be addressed explicitly in the FAA's regulations. That has now changed.

The commercial space transportation industry continues to grow and diversify. Between the first licensed commercial launch in March 1989 and July 2000, 130 licensed launches have taken place from five different launch sites, including launches from a non-federal launch site, and from launch sites operated by licensed launch site operators. The vehicles have included traditional orbital expendable launch vehicles, such as the Atlas, Titan, and Delta, and sub-orbital Black Brant boosters, new expendable launch vehicles using traditional launch techniques, such as Athena and Conestoga, and unique vehicles, such as the air-borne Pegasus. The commercial launch industry has evolved from one relying on traditional orbital and sub-orbital launch vehicles to one with a diverse mix of vehicles using new technology and new concepts. A number of international ventures involving U.S. companies have also formed, further adding to this diversity.

Developments in cost savings and innovation are not confined to the launch industry. The launch site industry has also made progress. Commercial launch site operators are coming on line with the goal of providing flexible and cost-effective facilities both for existing launch vehicles and for new vehicles. When the commercial launch industry began, commercial launch companies based their launch operations at federal launch ranges operated by the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA). The Eastern Range, where the 45th Space Wing provides launch safety services, located at Cape Canaveral Air Station in Florida (CCAS), and the Western Range, where the 30th Space Wing provides launch safety services, located at Vandenberg Air Force Base (VAFB), in California are Federal launch ranges that support licensed launches. Both are operated by the U.S. Air Force. Wallops Flight Facility in Virginia, operated by NASA; White Sands Missile Range (WSMR) in New Mexico and Kwajalein Missile Range, both operated by the U.S. Army; and the Kauai Test Facility in Hawaii, operated by the U.S. Navy are other federal launch ranges that support licensed launches. Federal launch ranges provide the advantage of existing launch infrastructure and range safety services. Launch companies are able to obtain a number of services from a federal launch range, including radar, tracking and telemetry, flight termination and other launch services.

Today, most commercial launches still take place from federal launch ranges. However, the FAA anticipates that this pattern will change, as non-federal launch sites become more prevalent. On September 19, 1996, the FAA granted the first license to operate a launch site to Spaceport Systems International (SSI) to operate California Spaceport. That launch site is located within VAFB. Three other launch site operators have received licenses. The Spaceport Florida Authority (SFA) received an FAA license to operate Launch Complex 46 at CCAS as a launch site. Virginia Commercial Space Flight Authority (VCSFA) received a license to operate Virginia Spaceflight Center (VSC) within NASA's Wallops Flight Facility. Most recently, Alaska Aerospace Development Corporation (AADC) received a license to operate Kodiak Launch Complex (KLC) on Kodiak Island, Alaska as a launch site.

Whether launching from a federal launch range, a launch site located on a federal range, or a non-federal launch site, a launch operator is responsible for ground and flight safety under its FAA license. At a federal launch range a launch operator must comply with the rules and procedures of the federal range. The safety rules, procedures and practices, in concert with the safety functions of the federal launch ranges, have been assessed by the FAA, and found to satisfy the majority of the FAA's safety concerns. In contrast, when launching from a non-federal launch site, a launch operator's responsibility for ground and flight safety takes on added importance. In the absence of federal launch range oversight, it will be incumbent upon each launch operator to demonstrate the adequacy of its ground and flight safety to the FAA.

An NPRM containing licensing and safety requirements for the operation of a launch site was issued in June 1999, and that notice makes clear that a licensed launch site operator will not be playing the same role as a federal launch range. Licensing and Safety Requirements for Operation of a Launch Site, Notice of Proposed Rulemaking, 64 FR 34315 (Jun. 25, 1999) (''Launch Site NPRM''). That notice proposes specific requirements for operating a launch site, including the operation of a non-federal launch site; however, the notice proposes more limited launch site operator licensee requirements with respect to flight safety of a launch from a non-federal site. A launch site operator is not required to perform in a similar capacity as the current federal launch ranges. The FAA holds a launch licensee, not a launch site operator, responsible for flight safety, even in those cases where a launch site operator provides services in support of a launch. In that context, a launch site operator acts as a contractor or subcontractor to a licensed launch operator. The majority of public safety requirements for launch related ground and flight operations fall upon the launch licensee.

In addition to licensing the operation of the first non-federal launch site, the FAA issued, as of March 1999, its first launch license for launch from a non-federal launch site, which was, in this case, the Pacific Ocean. For this launch, no federal launch range safety review was available. Sea Launch Limited Partnership (Sea Launch), the licensee, was successful in conducting its first launch of a commercial rocket from a modified mobile oil rig located in the Pacific Ocean. Because Sea Launch does not plan to offer its launch platform or location to others for launch, the FAA did not require it to obtain a license to operate a launch site; accordingly, it needed only obtain a launch license. The FAA's approach to Sea Launch's license application was to ensure an equivalent level of safety as has been sought at the federal launch ranges. Although the foreign safety system, technology, procedures, and operations create a number of differences, the FAA was able to use the federal launch range approach as a benchmark to achieving safety for the FAA's safety determination.

The current regulations, 14 CFR part 415, governing launch primarily address launches as they take place from Department of Defense or National Aeronautics and Space Administration (NASA) launch ranges, and treat

launches from a non-federal launch site on a case by case basis. The licensing regulations for launch from a federal launch range are designed to avoid duplication of effort between the FAA and the federal launch ranges in overseeing the safety of launches at the federal ranges. Although the FAA does require information and analyses not required by federal ranges to ensure that all flight safety issues are addressed, and imposes certain additional requirements derived from recommendations arising from a National Transportation Safety Board investigation, the FAA does not duplicate the safety assessments performed by federal launch ranges. The ranges require compliance with their safety rules as a condition of using their facilities and services. The federal ranges act, in effect, both as landlords and as providers of launch facilities and services. Under this notice of proposed rulemaking, that licensing approach will continue. A launch operator license applicant proposing to launch from a federal launch range will continue to be governed by subpart C of part 415. A launch operator proposing to launch from a non-federal launch site would be subject to the requirements proposed by subpart F which are, because of the lack of federal launch range involvement, more detailed in order to permit the FAA to adequately review the safety of each proposed launch.

A federal launch range requires a launch operator to provide data regarding its proposed launch. The range evaluates the data to ascertain whether the launch operator will comply with range requirements. The range also uses the data to prepare range support for the mission. DOD ranges require that a launch operator apply for and obtain specific mandatory approvals from the range in order to conduct certain specified operations. For example, the Air Force's ''Eastern and Western Range Requirements 127–1,'' (Mar. 1995) [2] (''EWR 127–1'') require a launch operator to obtain approvals for hazardous and safety critical procedures before the range will allow those operations to proceed. In the event that a launch operator's proposal does not fully comply with range requirements, a range may issue a deviation or a waiver if the mission objectives of the launch operator could not otherwise be achieved. A range may issue a deviation to allow a launch even when a launch operator's designs or proposed operations do not comply with range requirements. A range may issue a waiver when it is discovered after production that hardware does not satisfy range requirements or when it is discovered that operations do not meet range requirements after operations have begun at a federal range. A range will allow a deviation or grant a waiver only under unique and compelling circumstances.

The FAA performed baseline assessments of various federal launch ranges and found their safety services adequate. Under FAA regulations, the FAA does not require an applicant to demonstrate the adequacy of the range services it proposes to employ if the applicable baseline assessment included those federal launch range services and if those services remain adequate. Certain showings regarding the applicant's own capabilities are still required. The FAA requires specific information regarding the interface between the safety organizations of a federal launch range and of an applicant. In the event that a service or procedure upon which an applicant proposes to rely is not within the documented experience of the federal launch range that the applicant proposes to utilize, the applicant would have to demonstrate the safety of that particular aspect of its launch. This is also true if a documented range safety service has changed significantly or has experienced a recent failure. In those cases, the burden of demonstrating safety shifts to the applicant.

III. Discussion of Proposed Licensing and Safety Regulations for Launch

A. Proposed Revisions to Parts 415 and 417

The approach the FAA followed in developing technical requirements for this proposed rule is to build on the safety success of federal launch ranges and to seek the same high level of safety that the federal ranges have achieved. Wherever appropriate for public safety, federal launch range practices were used as the basis for the development of the FAA's regulatory regime. Additionally, this proposed rule would allow for flexibility through the use of performance standards where appropriate, and identifies specific technical requirements where necessary to ensure safety. The FAA worked extensively with federal launch range safety personnel to refine and adapt many of the federal range requirements to a performance standard approach for incorporation into this proposed rule. The text responds to the complexity of space launch systems and the potential for negative consequences to public safety. The proposed regulations specify detailed processes, procedures, analyses, and general safety system design requirements. Where necessary, for critical safety hardware and software, this proposed rule provides design and detailed test requirements. In every case, the proposed regulations define the material that must be prepared and submitted as part of a license application or by a licensee before launch. The FAA also proposes to build flexibility into its requirements. Although the proposed regulations would provide the requirements with which a licensee must comply, the FAA anticipates that a launch operator might wish to employ alternative means of achieving the same safety goal. In that case, if a launch operator can clearly and convincingly demonstrate an equivalent level of safety, the FAA would consider accepting that alternative, and describing it for the benefit of others through the notice, the FAA's advisory circular process or some other method.

This notice of proposed rulemaking proposes safety requirements for licensed launch, whether from a non-federal launch site or a federal launch range. It is the FAA's understanding that the U.S. Air Force launch ranges intend eventually to cross-reference the same requirements for flight for government launches. In the course of creating the requirements for this proposed rule, the FAA consulted with the federal launch ranges. As a result of these consultations, what the FAA understands to be a general sentiment within the launch community in favor of consistent requirements, and the recommendations contained in the White House's report, The Future of the Space Launch Bases and Ranges, (2000) the FAA and the Air Force plan to establish common safety standards for the flight of a launch vehicle. The FAA will implement its requirements through rulemaking, and launch operators using Air Force ranges for commercial launch would have to abide by the FAA regulations for flight safety in proposed part 417. Because the Air Force's ground safety requirements still provide greater specificity than what the FAA proposes through this notice, the Air Force does not, at this time, plan to substitute the FAA's proposed ground safety requirements for its own, but, because a launch operator will have to comply with the requirements of part 417, that launch operator will have to ensure that it complies with the FAA's proposed ground safety requirements as well. The FAA anticipates that, in most instances, satisfaction of the Air Force

[2] The latest version of these requirements may be found at http://www.pafb.mil/45SW/rangesafety/ewr97.htm.

requirements will satisfy the FAA's ground safety requirements. In the event of conflicts, the FAA's requirements will govern licensed launch operators.

Both the Air Force and the FAA anticipate tangible benefits to having common safety standards. Because the FAA is building upon the requirements of the federal launch ranges, this proposed rule is meant to preserve the best of the Air Force public safety experience and expertise. The Air Force, which has subjected its own requirements to the scrutiny and comments of its range users in the past, will be able to rely on the fact that the FAA's proposed requirements will undergo the public notice and comment period mandated by the Administrative Procedure Act. This proposed rule will provide a forum for public participation on the proposed standards and economic impacts. An FAA rulemaking requires a cost benefit analysis, which is also subject to public comment, and ensures that issues regarding cost are taken into account. The FAA, in turn, is able to leverage the technical expertise of the Air Force legacy in promulgating its requirements. The FAA and the Air Force foresee greater ease of administration for launch operators and the government, as well as greater uniformity of treatment, with a common set of national standards.

This notice proposes to establish requirements for a flight safety analysis that covers the hazards of normal and non-normal flight. The results of the analysis will be used to develop and implement flight safety rules and procedures that govern the licensed launch. The flight safety analysis is a critical tool for determining that public safety is being adequately addressed. The analysis must accurately reflect the true circumstances of each launch. Consequently, the proposed rules would specify performance standards for each critical part of a flight safety analysis as well as identifying the specific safety criteria that must be met.

This notice would cover a number of major flight safety analysis issues. Flight control lines are necessary for a flight safety analysis. Establishing flight control lines involves the identification of those areas that must be protected from potential adverse effects of a launch vehicle's flight. Flight control lines are material input to the flight safety analysis and the determination of flight safety limits. They depend on the location of population centers, foreign territorial boundaries, and other areas that must be protected. Flight safety limits are used during a launch to determine when a malfunctioning vehicle's flight must be terminated to ensure that any adverse effects are contained. Flight safety limits may be a function of time and depend on the vehicle's debris footprint.

This notice of proposed rulemaking addresses other flight safety measures. For example, wind weighting is a technique used to determine launch azimuth and elevation settings for unguided launch vehicles, which are typically sub-orbital sounding rockets. Wind weighting predicts the wind effects on impact point displacement during the thrusting phases of flight as well as the ballistic free-fall phase of each launch vehicle stage.

Hazard areas must be established for both preflight processing of a launch vehicle and flight. Hazard areas are established to provide protection from both normal and anomalous launch events. The presence of the public in a hazard area is a constraint on preflight processing and flight, and must be controlled, typically by controlling access to the area or through flight commit criteria that depend on real-time surveys of the area at the time of flight. This notice proposes to specify the analysis that a license applicant must perform to define the appropriate hazard areas for each launch. These hazard areas generally include a launch hazard area that accounts for people, aircraft, and any ships, impact hazard areas for planned debris resulting from normal flight, and hazard areas for unique hazards such as toxic or radiological materials.

An applicant must demonstrate satisfaction of the FAA's risk criteria. This may be accomplished if a launch operator is able to show that the risk of casualties to the general public is acceptably low. An applicant must show that the collective casualty expectancy (E_C) risk of the proposed launch is equal to or less than the FAA's established criteria of 30×10^{-6}. This is a critical measure used to evaluate potential public risk due to a proposed launch. An applicant must also show that its proposed launch will be conducted without exceeding an individual casualty probability (P_C) of 1×10^{-6}. Not all federal launch ranges require an individual risk analysis. In most cases, if 30×10^{-6} is met, individual risk is also less than 1×10^{-6}. This is not, however, always the case. The need to evaluate individual risk varies depending on the specifics of the launch and the launch site. Because FAA regulations must address the broad range of non-federal launch sites and launch vehicle combinations, the FAA proposes to require a launch operator to demonstrate that the individual risk criteria will not be exceeded for each launch regardless of whether the launch occurs from a non-federal launch site or a federal launch range. This notice will provide a method for accomplishing these analyses and allow for variations and possible simplifications to the analysis based on the applicant's specific situation. The applicant would perform risk analysis to demonstrate that each proposed launch will not exceed established criteria for the impact probability of hitting aircraft and ships.

The other essential component for flight safety is a flight safety system. The primary purpose of a flight safety system is to monitor a launch vehicle's flight status and provide the positive control needed to prevent the launch vehicle from impacting populated or other protected areas in the event of a vehicle failure. The requirements for properly qualifying the proposed flight safety system and validating its performance are critical. Comprehensive flight safety system requirements will be provided that are designed to ensure that a launch operator implements a highly reliable, acceptable system.

This proposed rulemaking addresses important components of and major issues related to a flight safety system. A typical flight safety system is composed of a flight termination system and a command control system. This notice proposes to define a flight termination system (FTS) as consisting of all components that are on board a launch vehicle and are needed to control the termination of a launch vehicle's flight. An FTS may also include automatic destruct system components designed to activate upon vehicle breakup or premature separation of individual powered stages or strap-on motors. This notice proposes requirements for the FTS components onboard a launch vehicle as well as command control components that are typically ground based, including associated software. A highly reliable FTS is critical to ensuring public safety. This notice would define a process for obtaining the necessary reliability. That process would consist of specific FTS design standards and criteria, a reliability analysis of the FTS design, and comprehensive testing to qualify the FTS design and certify and accept FTS components.

The proposed requirements would also address other elements of the flight safety system. This notice of proposed rulemaking would include requirements for compatible vehicle tracking, visual data sources, telemetry, communications, display, and recording systems that are necessary as part of the flight safety system to support a flight

termination decision. The licensee would be responsible for ensuring that these required systems are available to support the launch. A flight safety system must be complemented with, and operated by a qualified flight safety crew that includes a flight safety official and support personnel. This proposed rule would identify the flight safety crew positions and the personnel qualifications required for each position. The FAA's proposed training and qualification approach is an adaptation of federal launch range practices.

This notice also addresses ground safety issues related to the preparation of a launch vehicle for flight. Many issues related to the safety of ground operations at a launch site are subject to regulation by other federal agencies. This notice would address ground safety issues, not otherwise addressed by other federal regulations, that are unique to space launch processing and that could affect the general public. A launch operator licensee would be responsible for developing and implementing a ground safety program in compliance with the specified standards, and should note that this proposed rulemaking does not supersede the ground safety requirements of other regulatory agencies.

Ground safety issues may be addressed through a number of measures in this notice. This proposed rulemaking includes a hazard assessment to ensure the safety of ground operations. A launch operator would be required to perform a hazard analysis for all hazardous operations to identify the potential of each hazard for affecting public safety. This proposed rulemaking would define requirements, processes, and procedures for mitigating identified public safety hazards. Launch processing typically involves the use of toxic and hazardous materials. This proposed rule would define ground safety program requirements designed to protect the public from these substances. The use of non-ionizing radiation in the form of communications and radar systems is also typical of launch processing. Proper control of such sources of energy is of particular concern due to the many explosives that could be inadvertently initiated and that are often present at a launch site. This proposed rulemaking would define ground safety program requirements designed to protect the public from non-ionizing radiation. A launch vehicle or payload may include materials that give off ionizing radiation. The presence of ionizing radiation is a safety issue that must be reviewed for each launch and requires that proper procedures be followed. There are many ground safety issues involving explosives associated with launch processing. The NPRM on licensing and safety requirements for the operation of a launch site addresses locating explosive substances at a launch site, and identifies appropriate safety separation distances, based on quantity, between facilities at the site and the public. In most cases, maintaining proper separation distances will provide protection for the general public. This proposed rulemaking would define ground safety program requirements for protecting the public from explosives through the maintenance of proper separation distances during operations and preventive explosive safety processes and procedures, including prevention of inadvertent initiation of explosives and propellants.

B. Payload Review and Determination

The proposed requirements address hazards that a payload may create during launch. This proposed rulemaking continues the agency's practice of addressing hazards presented by payloads during the flight of a launch vehicle. This includes payloads otherwise exempt from a payload review. The FAA wishes to clarify that flight safety analysis includes even those payloads exempted by 14 CFR 415.53, and is proposing to amend the text of § 415.51 to clarify accordingly. As is evident from inspection of the neighboring provisions, sections 415.51 (''the FAA reviews a payload proposed for launch to determine whether its launch would jeopardize public health and safety'') and 415.53 (''each payload is subject to compliance monitoring to determine whether its launch would jeopardize public health and safety''), the FAA intended to include safety issues within a payload review. Nonetheless, in order to avoid confusion, the FAA proposes to amend § 415.51 to state that all payloads, exempt or not, are subject to the safety requirements of subparts C and F of this part and of part 417. This should make clear that the exemption of Federal Communications Commission (FCC) or National Oceanic & Atmospheric Administration (NOAA) regulated payloads or those owned or operated by the U.S. Government applies to the payload determination and not to the safety reviews or requirements.

The Act provides the FAA authority over payloads. *See* 49 U.S.C. 70104; Commercial Space Transportation; Licensing Regulations, Interim Final Rule, 51 FR 6870, 6871 (Feb. 26, 1986) (''The Act gives the [agency] authority to determine whether the launch of a payload is inimical to the national interests specified in the Act and does not exclude any relevant factor from the [agency's] consideration.'') The commercial space transportation regulations implemented this authority, first, through a mission review, *see* 14 CFR 415.21–415.25 (1988), and then through the payload review adopted in 1999, *see* 14 CFR 415.51–415.63 (1999).

The Act also contains provisions describing the authority of various agencies with regard to certain payloads. The Act does not affect the authority of the FCC or the Secretary of Commerce under the Land Remote-Sensing Commercialization Act of 1984. 49 U.S.C. 70117(b). This means that these agencies may continue in their regulation of communications satellites and land remote sensing satellites. Accordingly, the FAA does not conduct a payload review of payloads that are subject to regulation by the Federal Communications Commission or the Department of Commerce, National Oceanic and Atmospheric Administration, or that are owned or operated by the U.S. government. This means that the FAA does not review those payloads for their impact on the national interests identified in the Act.

The FAA does, however, possess and exercise safety authority over issues presented by payload hazards during flight of a launch vehicle. The FAA recognizes that the legislative history accompanying the requirement in 49 U.S.C. 70104(b) that a licensee may launch a payload only if the payload complies with the requirements of the laws of the United States related to launching a payload, indicates that Congress did not want communications or land remote sensing satellites subjected to a duplicative regulatory process. See Commercial Space Launches, Sen. Committee Rep. No. 656, 98th Cong., 2d Sess., 15 (1984). The Committee recognized, for example, that the FCC provided authorization for the launch of a communications satellite and would therefore require no separate ''documentation or certification'' by the FAA. *Id.* Nor did Congress intend that the FAA obtain the authority ''to override or modify any decision by the FCC to authorize the launch or operations of a communications satellite.'' *Id.* at 16. The FAA does not purport to authorize the operation of communications satellites. That is why the exemption in § 415.53 exists. What the FAA does require, however, is information sufficient to evaluate the safety of a proposed launch. The FCC and NOAA do not analyze the launch safety of communications or land remote sensing satellites. Accordingly,

the FAA's proposed safety requirements would not constitute duplicative regulation.

If the payload hazards dictate a change in commit criteria, trajectory or other safety related decision, the launch operator and the FAA need to be able to assess and respond to the hazards posed by the satellite. A satellite's hazards may consist of fuel, debris or both. In this regard the FAA notes that the Senate Committee, in discussing the agency's authority to issue an emergency order stopping a launch, recognized that the agency could have concerns ''that may relate to the launch vehicle or its payload.'' *Id.* at 24. This explicit recognition of the FAA's ability to respond to payload concerns supports the FAA's interpretation of the Act: subsection 70117(b) provides that the authority of the FCC and NOAA remain unaffected by the Act, but means nothing more than that. Although the FAA should not duplicate the roles of the FCC or NOAA, it may address areas not otherwise encompassed by their regulatory schemes, namely, the safety issues surrounding any particular launch. Accordingly, the FAA will continue to address payload safety issues that relate to the transport, or launch, of a payload, regardless of whether the payload is within the jurisdiction of the FCC or NOAA or whether it is owned or operated by the U.S. Government.

C. Safety Review for Launch From a Non-Federal Launch Site

Under current practice, the FAA requires a safety review for launch from a non-federal launch site. By this proposed rulemaking, the FAA proposes to codify its requirements for the safety review. Proposed part 417 contains the safety requirements with which a licensee must comply. Part 415, subpart F, would require a license applicant to demonstrate how it will satisfy the requirements of part 417 in order to obtain a license. The FAA would issue a safety approval if an applicant demonstrated that it would meet the safety responsibilities and requirements for launch. The safety review would require an applicant to submit data, prepare test plans, conduct and supply analyses and do so in accordance with specified timetables.

Not unlike what a launch operator must submit to a federal launch range in order to launch from a site such as Cape Canaveral or Vandenberg Air Force Base, a launch operator must demonstrate that it will satisfy the FAA's regulatory requirements. A launch operator will notice some differences. The same work will be performed, but by different entities. Where, for example, a federal launch range will perform much of the flight safety analysis for a launch operator to launch, the lack of a federal range and the proposed requirements would settle that task upon the launch operator. In the course of its safety review, the FAA will review the launch operator's information for validity and accuracy.

D. Part 417, Launch Safety

This proposed rulemaking clarifies the roles and responsibilities of a launch operator licensee. It specifies that a launch operator is responsible under an FAA license for the safety of the flight of its launch vehicle and the launch processing, or preparation of that launch vehicle for flight, at a U.S. launch site.

A launch license encompasses both the flight of a launch vehicle, referred to in common parlance as ''launch,'' and the launch processing of that vehicle. One of the idiosyncrasies of the Act is its definition of ''launch.'' The Act defines launch not only as including the flight of a launch vehicle, but as including activities ''involved in the preparation of a launch vehicle or payload for launch, when those activities take place at a launch site in the United States.'' 49 U.S.C. 70102(3). Accordingly, a launch license covers flight and launch processing, and a launch operator is responsible for the safety of both.

This proposed rulemaking also clarifies a number of issues of which a launch operator must be cognizant. A launch license does not relieve a licensee of other legal obligations. Under 49 U.S.C. 70105(b), unless otherwise provided by that subsection, all requirements of the laws of the United States applicable to the launch of a launch vehicle are license requirements as well. Additionally, this proposed rulemaking would impose on a launch operator the requirement to coordinate with a launch site operator in order for the launch site operator to satisfy its regulatory obligations.

The proposed requirements also highlight the interplay between the application process and compliance with the obligations of a licensee. Because the FAA grants a license based on the representations contained in a launch operator's license application, part of a licensee's obligations under its license are to ensure the continuing accuracy of all material representations. The FAA proposes to impose affirmative verification measures in order to ensure that a launch operator is operating as it represented it would.

In order to outline the proposed regulations, proposed subpart B of part 417 would serve as a guide to other parts of the regulations. It summarizes what a launch operator needs to address to achieve public safety and refers to the particular subpart, section and appendices that contain detailed requirements. This subpart would address a launch operator's safety organization, safety personnel and codify various criteria for the risks and hazards associated with launch.

E. Flight Safety Analysis

1. Introduction

A launch operator would be required to perform flight safety analysis to demonstrate how it would monitor and control risk to the public from hazards associated with normal launch vehicle flight and the potential hazards associated with the flight of a malfunctioning launch vehicle. The proposed regulations would require that a launch operator's analysis consist of a number of separate analyses, both deterministic and probabilistic in content and intent. For all expendable launch vehicles, a launch operator's flight safety analysis would determine the conditions under which the vehicle could be launched safely by demonstrating that the risk associated with the launch satisfied the public risk criteria. In addition, for a launch vehicle flown with a flight safety system as a means of ensuring public safety, the flight safety analysis would define the conditions that would dictate whether or not the flight of the launch vehicle had to be terminated due to safety considerations.

During the licensing process, the FAA would require a launch operator to submit the products of its analysis to demonstrate that the launch operator performed the required analyses properly and has the ability to conduct a launch safely. After licensing, the FAA would also require a launch operator to submit analysis products for each individual launch to provide the data that the FAA would use to verify a launch operator's compliance with the regulations and the terms of the license for each launch. The proposed analyses would thus demonstrate both capability and specific compliance. This has proved to be a successful process historically. The FAA does not, however, foreclose the possibility that a launch operator could dispense with one or more of the proposed analyses through innovation or the applicability of a previously performed analysis for a past mission to a planned mission. Nonetheless, the FAA would require the products of each of these analyses to verify their validity for those launch

operators employing the more traditional approaches, and to serve as a benchmark against which to measure any alternative approach that a launch operator proposes.

2. Flight Safety Analysis for Launch Vehicles That Use a Flight Safety System to Achieve Public Safety

A launch operator would perform a series of analyses to define the extent of its launch vehicle's capabilities and hazards, both during normal flight and in the event of a malfunction. A launch operator would perform a trajectory analysis to determine a launch vehicle's planned nominal trajectory and the potential three-sigma trajectory dispersions about the nominal trajectory. The three-sigma dispersions, which routinely include the effects of winds on a launch vehicle, about the nominal trajectory define the extent of normal flight. A launch operator would perform a malfunction turn analysis to determine how far a launch vehicle's instantaneous impact point can deviate from the nominal trajectory when a malfunction occurs. A launch operator would perform a debris analysis that identifies inert, explosive, and other hazardous launch vehicle debris, such as toxic debris or debris that produces ionizing radiation, resulting from a launch vehicle malfunction and from any planned jettison of launch vehicle components. A launch vehicle's capabilities and hazards may be significantly affected by winds experienced during flight. A launch operator would perform a wind analysis to determine wind magnitude and direction as a function of altitude for the air space through which the launch vehicle will fly and for the airspace through which any malfunction and jettisoned debris may fall.

The launch operator would perform an analysis to establish flight control lines that define where a launch vehicle would be allowed to fly. As part of this analysis, the launch operator would assess the surroundings of its proposed launch site and trajectory to identify the boundaries of populated and other areas requiring protection from the potential adverse effects of the launch vehicle's flight, including, its possible breakup, whether commanded or accidental. The proposed regulations would require a launch operator to border the identified populated and other areas requiring protection with flight control lines, thus defining the region within which the launch vehicle and any breakup and jettisoned debris must be contained.

The FAA reviewed a recent National Academy of Sciences (the Academy) study that recommended that the federal launch ranges create their impact limit lines, which correlate fairly closely to the FAA's own proposed flight control lines, on the basis of risk. Streamlining Space Launch Range Safety, 22, National Research Council (Apr. 2000) (''Streamlining Safety''). The Academy recommended, among other things, that destruct lines be defined and implemented in a way that is directly traceable to accepted risk standards, including collective (E_C) and individual risk. The Academy took exception to the creation of impact limit lines on the basis of risk avoidance. *Id.* at 20 (citing EWR 127–1, par. 2.3.6: ''Whenever possible, the overflight of any inhabited landmasses is discouraged and is approved only if operational requirements make overflight necessary, and risk studies indicate probability of impact and casualty expectancy are acceptable.'') The FAA finds that it cannot pursue this recommendation. In the context of impact limit lines, the report makes no case for basing a decision as to what requires protection on the basis of risk. Instead, it ignores the portion of EWR 127–1 that permits overflight on the basis of risk through the creation of gates, which are the width of a destruct line opened for a normally performing vehicle,. Gates are acceptable only if risk levels are acceptable. EWR 127–1 at par. 2.3.6. The FAA proposes, like the federal launch ranges, to require the protection of populated areas, and permit the creation of gates as an exception to the flight control lines requirement. If the Academy means to suggest that impact limit lines or flight control lines should be created on the basis of risk, the Academy did not suggest how this should be accomplished or provide a justification. The FAA is also troubled by the possibility that the Academy recommendation could mean that certain populated areas and members of the public near a launch site would no longer benefit from being protected from a malfunctioning launch vehicle. The FAA does not believe that the Academy intended to distinguish between the levels of protection some members of the public are afforded. Accordingly, the FAA will not seek to deviate from the federal launch range approach to the creation of either impact limit lines or, as the FAA proposes, flight control lines.

The launch operator would perform a series of analyses to determine the conditions that would require termination of a launch vehicle's flight and to establish flight termination rules. Unless otherwise approved during the licensing process, the proposed regulations would require a launch operator to employ a traditional U.S. flight safety system where flight termination is accomplished by destroying the launch vehicle and ensuring that any resulting hazards are contained within an area that is isolated from the public. In general, if a launch vehicle strays off course, it must be destroyed or its thrust terminated before the vehicle, payload, or resulting debris is able to impact any populated or other protected area outside the established flight control lines.

A launch operator would perform a flight safety limits analysis and institute flight termination rules to establish the conditions under which the launch operator would have to terminate a malfunctioning launch vehicle's flight to ensure that the launch vehicle's debris impact dispersion does not extend beyond the flight control lines, or conflict with the risk criteria. A launch operator's flight safety limits analysis would have to account for any time delay that exists between recognizing that a malfunction has occurred, the point in time that a flight termination command is sent and the launch vehicle's destruction. A launch operator would perform a time delay analysis to determine the elapsed time, including an allowance for the flight safety official's decision and reaction time, between the start of a launch vehicle malfunction or violation of flight safety limits and the final motion of the vehicle's impact point or commanded flight termination.

Additional proposed analyses would address other conditions requiring termination of flight. If a launch vehicle malfunctions and flies a vertical or near vertical trajectory, usually referred to as a straight-up trajectory, rather than following a normal trajectory downrange, a launch operator would perform a straight-up time analysis to determine the latest time-after-liftoff by which flight termination must be initiated. If a launch operator lost all launch vehicle tracking data and did not regain tracking data for an amount of time sufficient for a launch vehicle to reach a populated or other protected area, the launch operator would have to terminate flight. A launch operator would perform a data loss flight time analysis to determine the shortest elapsed thrusting time during which a launch vehicle could move from its normal trajectory to a condition where the public might become endangered.

The FAA would permit flight over any populated or other protected area if a launch operator establishes a gate through a flight control line or other flight safety limit boundary. A launch

operator would perform an analysis to determine any gate in a flight control line or other flight safety limit boundary, through which a launch vehicle would be allowed to pass without a launch operator being required to terminate flight. A launch operator would have to perform a risk analysis to determine whether the overflight permitted by the gate was acceptable and satisfied the risk criteria.

The FAA wishes to caution its licensees that proposed changes in the African gate may affect certain launches, and requests comments from its licensees on the possible impacts. A licensed launch operator would have to satisfy the requirements of proposed part 417. That would include the requirements governing the creation of a gate. The National Academy of Sciences report recommended that the Air Force consider not retaining downrange equipment and facilities in support of the African or other gates. Streamlining Safety at 24. If such a move conflicted with the FAA requirements governing creation and use of a gate, a launch operator would have to provide its own support for any launch employing the gate.

The FAA's proposed requirements would require a launch operator to terminate the flight of an abnormally performing launch vehicle prior to permitting land overflight. The Academy pointed out, without quantifying the costs, that the current downrange equipment that supports a termination decision is expensive. Streamlining Safety at 20. The Academy also noted that coordinating launches with remote facilities complicates range safety operations and increases the risk of delay. *Id.* The Academy also maintained that the need for downrange facilities was not necessary from a safety perspective. The FAA requests public comment on the Academy's position in light of the considerations addressed below.

The Academy argued for removal of the downrange facilities from a safety perspective. It stated that several factors suggested that the risk standard could still be satisfied with fewer facilities. In pursuit of this argument, the Academy reviewed the collective risk associated with launch of an Atlas. Streamlining Safety at 20–22. It did not, however, address launches that might present worst case scenarios such as the evolved expendable launch vehicles, whose flight time and opportunity for some type of malfunction between last contact and the commencement of overflight will be correspondingly greater, and whose instantaneous impact point range rate will be slower and whose dwell time over Africa or Europe will increase proportionately. Accordingly, the FAA believes that before it is possible to determine whether downrange facilities are superfluous to safety that a good analysis would consider the contribution of the overflight of launch vehicles other than an Atlas to the total mission risk, and whether those contributions would result in E_C being exceeded.

Additionally, although Streamlining Safety quantifies the probability of impact to Africa, it does not provide the expected casualty contribution of that overflight. Instead, it cites a report regarding downrange risks created by an Athena or Titan launch vehicle for the proposition that ''the risks from flying over Africa appear to be well within the standard acceptable for the U.S. population.'' *Id.* at 21 (citing ''Estimation of Downrange Risks for Northeast Titan and Athena Launches,'' Research Triangle Inst., Ward (1997)). Whether these conclusions apply to an Atlas launch vehicle as well is unclear. Additionally, it is unclear whether the Academy's observations regarding the risks associated with the remainder of a launch mean that the Academy is aggregating the mission risks as it should, or applying different E_c thresholds to the populations of different continents. The FAA would appreciate any available clarification to this possible ambiguity.

Additionally, the FAA believes that the relationship of downrange risk analysis and the African Gate needs further clarification. When performing a risk study, the federal launch ranges do not look at regions of overflight unconstrained, but rather narrows their analysis to a hazard corridor defined in part by the width of the African or European Gate. In fact, because most launches are over the less densely populated southern half of Africa, moving the gate uprange could enlarge the hazard corridor for overflight and include higher population centers. Determining a gate, which is the width of a destruct line opened for a normally performing vehicle, would become dependent on the region of overflight for which risk has been accepted and the modes of failures considered in the risk analysis. Thus, by moving the gate further uprange, a concern over the proper gate width is created and needs to be defined. Should this be based on some limited vehicle performance, such as three-sigma performance, as suggested by the Academy's references to Western Range restrictions of flight azimuths, or more in terms of the maximum performance that will still allow orbital insertion as implemented by the Eastern Range? The latter is less restrictive than three-sigma vehicle performance requirements and allows larger overflight regions than if based strictly on three-sigma performance.

In accordance with this notice of proposed rulemaking, a launch operator would also perform a series of analyses to determine the safety conditions and criteria under which the flight of a launch vehicle might be initiated. A launch operator would perform a flight hazard area analysis to determine the land, sea, and air regions that would have to be publicized, monitored, controlled, or evacuated at the time of flight in order to inform the public and comply with the risk criteria in the event of planned and unplanned launch vehicle flight events. The hazard area analyses would contain both probabilistic and deterministic elements and would provide the launch operator the information necessary to establish exclusion, notice and surveillance zones, as well as other information required for flight commit criteria, which are the criteria which must be satisfied prior to flight. In order to meet flight commit criteria, a launch must comply with both the individual and collective risk criteria during planned and unplanned launch vehicle flight events. Hazard area analysis would include a blast hazard area analysis and determination of ship, aircraft, and individual risk hazard areas. A launch operator would perform a debris risk analysis to determine the expected average number of casualties to the collective and individual members of the public exposed to inert and explosive debris hazards from the proposed flight of a launch vehicle. This analysis would include an evaluation of risk to populations on land, including regions of launch vehicle flight following passage through any gate in a flight safety limit boundary. A launch operator would perform a toxic release analysis to determine the extent and amount of any public hazard resulting from any potential toxic release during preflight processing and flight of a nominal or non-nominal launch vehicle and to develop launch safety rules, including flight commit criteria to protect the public from any potential toxic release. A launch operator would perform a distant focus overpressure blast effects risk analysis to demonstrate that the potential public hazard resulting from impacting explosive debris would not cause windows to break with related injuries. This analysis would also contribute to any flight commit criteria necessary to comply with the public risk criteria.

Further discussion on the distant focus overpressure blast effects risk analysis is provided in section III.E.5 of this discussion.

A launch operator would obtain a conjunction on launch assessment performed by United States Space Command to identify any periods of time, referred to as ''waits,'' within a planned launch window, during which period flight would not be permitted in order to maintain a 200-kilometer separation between the launch vehicle and any inhabitable orbiting object.

3. Aircraft and Ship Hazard Areas for Guided Launch Vehicle and Unguided Suborbital Rocket Launches

The proposed regulations would require a launch operator to determine aircraft and ship hazard areas. Near the launch point, these hazard areas would constitute part of a flight hazard area. Outside the flight hazard area, aircraft and ship hazard areas would be necessary to protect against planned stage impacts and other intentionally ejected debris such as a fairing, payload, or other component. The FAA proposes requirements for launch operators to provide information for public notification of aircraft and ship hazard areas, and proposes requirements for when such hazard areas would have to be surveyed to ensure that the public risk criteria are satisfied for each launch.

a. *Aircraft hazard areas.* For the protection of aircraft during flight of a guided launch vehicle or an unguided suborbital rocket, the FAA proposes to require that a launch operator initiate flight only if the probability of the launch vehicle or debris impacting any individual aircraft that is not operated in direct support of the launch does not exceed an individual probability of impact of 0.00000001 ($P_i \leq 1 \times 10^{-8}$).

For the immediate area around the launch point, the proposed regulations would require a launch operator launching a guided launch vehicle to establish an aircraft hazard area. The aircraft hazard area would consist of and encompass the air space region defined by the flight hazard area, which would, in turn, encompass an aircraft-hit contour that shows where the probability of impacting an unrelated aircraft would exceed 1×10^{-8}, with an altitude extending from zero to 60,000 feet. For an unguided suborbital rocket, for the protection of aircraft, a launch operator's flight hazard area would be required to encompass the unguided suborbital rocket's three-sigma trajectory dispersion in the air space region from the Earth's surface at the launch point to an altitude of 60,000 feet.

For each downrange planned impact of a launch vehicle stage or component, the proposed regulations would require a launch operator to establish aircraft impact hazard areas to ensure that the 1×10^{-8} criterion is satisfied. The proposed regulations would also require that an aircraft hazard area for a planned impact encompass the three-sigma dispersion of the impacting launch vehicle stage or component. This requirement is intended to provide a high level of assurance both that a hazard area encompass the planned debris within the hazard area and that risk remains at acceptable levels. The FAA proposes that a launch operator ensure that an aircraft hazard area encompasses an air space region that contains the larger of the three-sigma impact dispersion ellipse or an ellipse, where, if an aircraft were located on the boundary of the ellipse, the probability of hitting the aircraft would be less than or equal to 1×10^{-8} and the debris path from an altitude of 60,000 feet to impact on the Earth's surface. This would ensure that a hazard area encompasses where the debris would fall and confines the area of risk. This requirement would apply to planned impacts from both guided launch vehicles and unguided suborbital rockets. A launch operator would have to ensure through communication with the FAA's air traffic control (ATC) facility having jurisdiction over the affected airspace that notices to airmen were issued and in effect at the time of flight for each aircraft hazard area.

Although an aircraft hazard area serves, through notices to airmen, to exclude or warn away aircraft from travelling too close to a launch, the size of that hazard area is usually determined through probabilistic means, and the FAA proposes to continue that practice. In other words, no aircraft would be allowed where the risks of impact are too great. Under current practice the federal launch ranges provide the air traffic control facility the outlines of an aircraft hazard area of which aircraft are notified. The federal launch ranges determine those aircraft hazard areas on the basis of the risk presented. NASA's Wallops Flight Facility implements an aircraft hit probability that equates to an individual aircraft hit probability of 1×10^{-8}. *See* Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility, RSM–93, 24 (1993) (applying 1×10^{-7} criteria to 10 aircraft). Although EWR 127–1 does not contain an impact probability criteria, the Western Range employs an aircraft hit probability of 1×10^{-8} for planned impact hazard areas. Through this notice, and consistent with current practice as articulated by Wallops and the Western Range, the FAA proposes to follow the same course.

In its report on space launch range safety, the National Academy of Sciences suggested 1×10^{-6} as the appropriate measure of probability of impact. Streamlining Safety at 38. The Academy maintained that its proposal was more consistent with the individual ship hit impact probability criteria and E_c. *Id.* The FAA understands that the 1×10^{-6} aircraft hit criterion is used by some federal ranges for aircraft that support a launch such as weather and launch surveillance aircraft. This criterion does not account for the large numbers of people that may be aboard an aircraft not involved in the launch. Because the FAA wishes to maintain the same level of public safety as achieved by the federal launch ranges, the FAA is not proposing the suggested measure, which constitutes an increase in risk to the public.

There is one special situation that arises in the context of suborbital rockets, and that has led the FAA to consider permitting a launch operator to propose the creation of alternate aircraft hazard areas. The large dispersions of some unguided suborbital rockets' planned impact points create a conundrum. The requirements for creating an aircraft hazard area unearthed certain incongruities where, on the one hand, satisfaction of the probability of impact criteria would create a hazard area of no significant size at all; while, at the same time, employing the criteria for the aircraft hazard area to contain the three-sigma impact dispersion could result in a hazard area that is prohibitively large to implement. The FAA proposes to resolve this difficulty through creation of an alternate hazard area.

For the launch of an unguided suborbital rocket, if the impact of a stage or component has a three-sigma dispersion that results in an aircraft hazard area that is prohibitively too large to implement with the ATC, a launch operator may employ an alternate aircraft hazard area. The FAA proposes that a launch operator provide a clear and convincing demonstration, through the licensing process, that any alternate aircraft hazard area provides an equivalent level of safety based on further analysis of the proposed launch and potential air traffic in the launch area.

b. *Ship hazard areas.* Through this notice of proposed rulemaking, the FAA proposes requirements designed to keep a launch vehicle and its components

from impacting ships when launching over water. A launch operator must identify where its launch vehicle's stages or other planned ejected debris or debris from a launch vehicle failure will impact, the corresponding ship hazard areas, whether the launch operator needs to survey the hazard areas for ships, and whether risks at the time of flight require that a launch operator wait until any ships have passed from a ship hazard area before initiating flight.

The standards governing the identification, surveillance and notice requirements for hazard areas for ships differ among the federal launch ranges based on their individual needs. The FAA's proposed requirements are an adaptation of the approaches used at the federal ranges resulting in a universally applicable approach. In accordance with the proposed requirements a launch operator would determine the collective probability of impacting a ship in the flight hazard area around the launch point and for each planned downrange impacting stage or component. The launch operator would perform a collective ship-hit analysis to determine the ship hazard areas and flight commit criteria and to determine whether the launch operator must survey the ship hazard areas. A launch operator would be permitted to initiate flight under these requirements only if the collective probability of impacting any ship would be less than or equal to 1×10^{-5}. If a launch operator demonstrates, using statistical ship density data, that the collective ship-hit probability in the flight hazard area around the launch point or for the planned impact of a stage or component is less than or equal to 1×10^{-5}, a launch operator would not need to survey the hazard area on the day of flight. Due to the uncertainty associated with statistical ship density data, the FAA is proposing that any ship density data obtained from a statistical source must be multiplied by a safety factor of 10 when used for any collective ship-hit probability analysis. This is because statistical density information is generally an average figure, does not reflect variances in time and is typically subject to limitations or other biases associated with deriving the density. If the launch operator fails to demonstrate that the collective ship-hit probability for the flight hazard area or an impacting stage or component is less than 1×10^{-5}, using statistical ship density data, the launch operator would be required either to compute the probability of hitting the actual ships surveyed on the day of flight or define ship-hit contours and ellipses, which the launch operator would be required to survey for ships on the day of flight.

The proposed requirements would permit a launch operator to launch only if the collective probability of hitting any ship was less than or equal to 1×10^{-5}.[3] A launch operator would determine this probability in one of two fashions. Under the first approach, a launch operator would, on the day of the planned flight, survey the ships in the vicinity of the flight hazard area and any planned impacts within 30 minutes of flight, and compute the probability of hitting a ship based on the number of ships surveyed. The analysis would account for the changes in impact locations resulting from any wind weighting operations on the day of flight, the speed of each ship in the vicinity of the impact area, and the ships' predicted location at the time of liftoff. The analysis would have to demonstrate that the collective probability of hitting a ship during flight was less than or equal to 1×10^{-5} in order for flight to occur.

If a launch operator preferred to conduct the analysis in advance of the day of flight, the launch operator could demonstrate that its launch would take place in accordance within the limit on the probability of impact by creating ship hit contours in the flight hazard area and ship-hit ellipses around each planned impact point. Ship-hit contours and ellipses would be required for one through ten ships in increasing increments of one ship. For a given number of ships, the associated ship-hit contour or ellipse would be required to encompass an area where if the ships were located on the boundary of the contour or ellipse, the probability of impacting one of the ships would be less than or equal to 1×10^{-5}. The launch operator would then survey on the day of launch to ascertain that less than the corresponding number of ships were present within each contour and ellipse. The launch operator would also have to create flight commit criteria that accounted for the winds used in the analysis in order to ensure that flight did not take place unless the winds on the day of flight were within the winds used in the analysis.

Through this rulemaking, the FAA proposes a refinement to the notice and surveillance requirements, as they are implemented at the federal launch ranges. As under current practice, the FAA proposes to require satisfaction of the 1×10^{-5} collective ship-hit criterion in order for flight to occur. What would change is the nature of the verification required. Today at the federal launch ranges, surveillance takes place for ships in the vicinity of the launch point. The ranges do not survey downrange planned impact points because they assume that ship density is significantly less in those downrange locations. Through this notice, the FAA would require a launch operator desirous of avoiding surveillance in the flight hazard area or downrange planned impact areas to obtain confirmation of the density of ship traffic and demonstrate that the probabilities of impact for each launch are below 1×10^{-5}, and the FAA would permit the use of statistical ship density data. Due to the uncertainty associated with any statistical ship density data and to make up for the lack of real-time surveillance, the FAA is proposing that any ship density obtained from a statistical source would have to be multiplied by a safety factor of 10 when used for the required collective ship-hit probability analysis. The FAA anticipates that in most cases of downrange planned impact, the criteria will be satisfied and that surveillance will continue not to be necessary. However, this approach would have universal applicability and would address a launch scenario with a planned impact point in an area where shipping density is relatively high and surveillance might become necessary in addition to posting a notice to mariners. For someone launching from the ocean, such as Sea Launch, surveillance requirements may decrease. However, the FAA does request public comment on this particular proposal and any available data that might show whether the criteria is indeed adequate to dispense with surveillance in either the flight hazard area or downrange.

As a final observation, the FAA is aware that the National Academy of Sciences addressed ship hazard areas and the requirements governing them in its study Streamlining Safety. *Id.* at 45. The Academy recommended that the federal launch ranges consider changing their threshold for probability of impact to increase the risk to ships and advised that the ranges conduct additional

[3] The practices at the Eastern and Western ranges differ with respect to the application of individual and collective impact probabilities. Because of the higher amount of ship traffic around Cape Canaveral, the Eastern Range conducts an analysis to ensure that it avoids hitting any ship. At the Western Range, where ship traffic is less dense, the Western Range usually ensures that the probability of impact for any individual ship does not exceed 1×10^{-5}. The Western Range has informed the FAA, however, that were it to experience an increase in ship density around Vandenberg Air Force Base, it, too, would have to employ a collective impact probability criteria. As things stand now, however, the Western Range need not and therefore does not currently employ that amount of analysis. Because of the differences in ship traffic densities, the actual level of safety is not significantly different between the two ranges.

studies. *Id.* at 37, 45. In the interest of maintaining the same level of safety as achieved by the federal launch ranges, the FAA is reluctant to follow this recommendation absent some compelling countervailing reason.

The Academy bases its recommendation on an argument for consistency between the ranges. Streamlining Safety at 45. Although the Eastern Range may initiate a launch hold or scrub if the collective risk exceeds 1×10^{-5}, the Academy thought that the inconsistency between this approach and the Western Range's use of individual risk and what it characterized as accepted guidelines for the evacuation of hazard areas called for the use of individual risk. The FAA is not persuaded that this apparent inconsistency provides sufficient grounds for change; more so, because, in actuality, the Western Range employs individual risk because it has less shipping traffic to address. Were ship densities higher, the Western Range would also employ collective risk to ensure that a launch did not place any ship at risk.

4. Flight Safety Analysis for Unguided Suborbital Rockets Flown With a Wind Weighting Safety System

A launch operator would perform flight safety analysis to determine the launch parameters and conditions under which an unguided suborbital rocket could be flown using a wind weighting safety system and without a flight safety system. The results of this analysis would demonstrate whether any adverse effects resulting from flight would be contained within controlled operational areas that are isolated from the public. The analysis would also have to show whether any flight hardware or payload impacts would occur within planned impact areas that are isolated from the public. If such containment and isolation cannot be achieved, the launch operator must conclusively show that any adverse effect resulting from flight will not exceed individual or collective public risk criteria. The launch operator would perform a trajectory analysis, a hazard area analysis, a debris risk analysis, analyses for toxic and distant focus overpressure hazards, and a conjunction on launch assessment similar to those required of a launch vehicle with a flight safety system. The launch operator would also perform a wind weighting analysis to determine launcher azimuth and elevation settings that correct for the windcocking and wind-drift effects on an unguided suborbital rocket due to wind forces.

A launch operator must identify the dispersion around its nominal drag impact location. The launch operator must identify that area by analyzing the performance error parameters associated with the rocket's design and operation. A performance error parameter acts as a source of deviation from nominal performance. It is a quantifiable perturbing force that contributes to the dispersion of the launch vehicle's drag impact point in the uprange, downrange and crossrange directions. Performance error parameters typically include thrust, thrust misalignment, specific impulse, weight, variation in firing times of the stages, fuel flow rates, contributions from the wind weighting safety system employed, and winds.

5. Protected Areas and Flight Control Lines.

For a launch vehicle that uses a flight safety system to ensure public safety, a launch operator would establish flight control lines that border populated and other areas requiring protection. By implementing flight safety limits and flight termination rules, a launch operator would keep debris created by a malfunctioning launch vehicle from impacting any populated or other protected area outside the flight control lines. As part of the analysis to determine flight control lines, a launch operator would identify the boundaries of the areas that must be protected. To account for the uncertainties in knowing exactly where a protected area is on the face of the Earth in relation to the position of a launch vehicle, a launch operator would add map and tracking errors to offset flight control lines from the protected areas. The flight safety limits would account for the errors and dispersions associated with the launch vehicle and flight safety system, which includes the flight termination sequence of events.

The FAA notes that the proposed flight control lines are not unlike the impact limit lines currently employed by the federal launch ranges. The FAA intends the flight control lines as general performance requirements and also notes that employing impact limit lines as implemented by the federal launch ranges would satisfy the FAA's proposed requirements. The FAA proposes to employ the different terminology to clarify what is to be protected. EWR 127–1 defines an impact limit line as a hazardous launch area and the boundary within which trajectory constraints and flight termination systems are used to contain an errant launch vehicle and vehicle debris. EWR 127–1 at 1–vii (Oct. 31, 1997). In practice, an impact limit line is not a ''line in the sand.'' A worst-case map and tracking error could result in an impact beyond an impact limit line without necessarily indicating a failure of the flight safety analysis or the flight safety system as long as there is no impact of a protected area. Thus, an impact limit line does not mark only what must be protected.

One of the proposed criteria for establishing flight control lines dictates that flight control lines must protect any land area not controlled by the launch operator. The FAA's protected areas would not only include towns, cities and other obviously populated areas, but all land areas outside the control of the launch operator because of the relatively high probability that people could be present on any land and the fact that any land may constitute property or contain the property of others. The safety of ships and aircraft would be addressed through the establishment of hazard areas and flight commit criteria as discussed earlier in this notice.

If the overflight of a land area not controlled by the launch operator is necessary as part of normal flight, it may be accomplished by first establishing the flight control lines and then establishing a ''gate'' in the flight control lines in accordance with the risk criteria for overflight of land. A launch vehicle would be allowed to pass through a gate only if the vehicle was performing within normal limits. The land areas within a gate are still considered protected. The flight control lines protect such land areas up until the launch vehicle enters the gate. If the launch vehicle began to malfunction before it reached the gate, the flight safety system would terminate the flight before the launch vehicle reached the flight control line or the gate. FAA requirements would permit the launch vehicle to enter the gate and overfly a land area only if the launch operator obtained positive in-flight verification that the launch vehicle had performed within normal limits up to that point and performance parameters indicated that the launch vehicle would continue to perform normally and the launch vehicle's dwell time was such that it satisfied the risk criteria.

In addition to using the flight safety system, flight control lines, and gates as positive deterministic means to protect people and property, the regulations would also allow application of risk assessment techniques to quantify the risk to people in a proposed land overflight for purposes of determining whether the risk remains within acceptable limits. In effect, a launch operator's debris risk analysis would serve to restrict land overflight on the basis of the size of the population in any

land overflown. For example, the FAA expects that no launch in the foreseeable future would be able to meet the E_C criteria of 30×10^{-6} if the planned trajectory involved placing a gate in a flight control line that would result in overflight of a city or other densely populated area.

Flight control lines present other issues as well. The FAA defines the public to include other launch operators located at the same launch site. See Launch Site NPRM, 64 FR at 34334. The FAA's proposed use of a flight safety system and flight control lines would not necessarily provide protection for the property of such launch operators.[4] This is in keeping with the current practice at the federal launch ranges. Currently, at the federal launch ranges, two launch pads may be situated such that if flight control lines were drawn to demarcate and protect the property of others, launch might not take place at all because the flight control lines might intersect the normal flight trajectory. The unintended consequence of such an intersection at a federal range would be the requirement to destroy a perfectly good launch vehicle.

The basis of the FAA's proposed approach to ensuring the safety of another launch operator's property at the launch site is that, unlike the general public outside the launch site, another launch operator is in a significantly better position to be informed of launch activities and to participate in decisions on the best way to protect its property. The safety of another launch operator's property would be addressed through efforts coordinated by the launch site operator. Launch Site NPRM, 64 FR at 34337, 34364 (proposed section 420.55 and accompanying discussion). In this case, the FAA would not mandate how the safety of property is achieved, but would require that the coordination take place. As part of coordination with a launch site operator, a licensed launch operator would be required to provide any information on its activities and its potential hazards necessary to determine how to best protect another launch operator's property. For example, through coordinated scheduling, another launch operator may simply elect to ensure that its launch vehicle is not present when another launch is scheduled.

The FAA's flight control line requirements are not intended to preclude private arrangements that would result in more narrowly drawn flight control lines. After all, a launch site operator would have responsibility for coordination of its customers. For launch sites located outside of a federal launch range, where a launch site operator has the opportunity to select optimum launch point locations, the site operator could site each launch point so that it would be protected by flight control lines. Such a site operator would also be free to designate contractually that certain areas or property at a launch site or downrange be protected by flight control lines. The federal launch ranges do this today, describing impact limit lines around downrange assets such as transmitters whose loss would disrupt not just one but many launches. By not requiring flight control lines to protect the property of others at a launch site the FAA does not mean to imply that a launch operator might not face liability for any damage it caused to the property of others. Accordingly, the FAA recognizes that a launch site operator, in fulfilling its obligations under proposed section 420.55, and a launch operator, in the interests of avoiding damage to the property of others, may wish to establish flight control lines more stringent than those required by the FAA's proposed regulations.

A launch site operator's ability to require a launch operator to establish flight control lines by contract may create some confusion as to what is mandatory under the regulations. Regardless of whether a flight control line imposed by a launch site operator is more stringent than FAA requirements or not, that flight control line would still be mandatory under FAA regulation. Although flight control lines drawn within a launch site are not themselves required by FAA regulations, they are mandatory once included within the launch operator's flight safety plan. Because a flight safety plan is approved as part of the licensing process, it is mandatory upon a licensee. *See* 14 CFR 415.73(a).

6. Distant Focus Overpressure Blast Effects Risk Analysis

A launch operator would be required to conduct an analysis to demonstrate that the potential hazard resulting from impacting explosive debris, including impact of an intact launch vehicle, would not cause public exposure to distant focus overpressure blast effects, sufficient to break windows and cause injuries. Impacting explosive materials, both liquid and solid, have the potential to explode. Given the appropriate combination of atmospheric pressure and temperature gradients, the impact explosion can produce distant focus overpressure at significant distance from the original blast point. Overpressures ranging from as low as 0.1 psi and greater may cause windows to break; but, depending on the size and thickness of windows and number of panes in each window in the locality of the launch site, other forms of overpressure such as multiple pulses may prove hazardous as well. Also, different levels of overpressure can occur at different distances depending on atmospherics and the explosive yield. A launch operator would have to address whichever levels and forms of overpressure created a hazard for the windows in the locale.

The distant focus overpressure explosion hazard primarily arises out of the impact of un-ignited solid propellant motors or failures of segmented motors so that portions of the motor impact intact,[5] and, when the weather conditions for inversion and lapse layers are right, the overpressure can focus in distant locations. A weather condition, referred to as an inversion, where sonic velocity increases with altitude, reflects the shock wave back toward the surface, where it can produce an increased overpressure at distances far from the source of the blast. The largest overpressure increase is produced from a caustic condition where the sonic velocity first decreases from its surface value and then increases beyond its surface value with increasing altitude.

The federal launch ranges typically assess the hazards of potential distant focus overpressure on a programmatic basis to determine if any population may be at risk for a given combination of launch vehicle and launch point. Based on this analysis a federal range may or may not perform an analysis for each launch. The FAA considered the option of not requiring this analysis. The FAA is aware of only a few launches involving the largest launch vehicles being delayed due to concerns regarding distant focus overpressure. This raised the question of whether sufficient grounds for concern exist to export this requirement to non-federal launch sites. However, because breaking windows or glass may cause injury to the public and the purpose of this rulemaking is to address all potential expendable launch vehicles, from all launch sites, the FAA proposes to retain this requirement. A launch operator would employ either a deterministic or

[4] The proposed regulations would provide for the safety of another launch operator's personnel through the establishment and evacuation of hazard areas for each launch.

[5] Liquid propellant impact explosions are rare because destruction of a launch vehicle through a flight termination action usually causes the liquid propellant to disperse prior to impact.

probabilistic analysis approach. For the deterministic approach, the launch operator would use the methodologies contained in the American National Standard Institute's ANSI S2.20–1983, ''Estimating Air Blast Characteristics for Single Point Explosions in Air with a Guide to Evaluation of Atmospheric Propagation and Effects'' to identify any populations that may be at risk and to establish flight commit criteria and other hazard mitigation measures. When using a probabilistic approach the launch operator would demonstrate through a distant focus overpressure risk analysis that the launch will be conducted in accordance with the proposed public risk criteria. The FAA proposes to evaluate any distant focus overpressure risk analysis on a case-by-case basis.

7. Dependent Analyses

Many of the proposed analyses are inherently dependent on one another. A launch operator would be required to ensure that each analysis product or data output is compatible in form and content with the data input requirements of any dependent analysis. A chart is provided in order to assist launch operators in determining which analyses depend on other analyses. The left column of figure 1 lists each analysis that is a source of data to be used as input by another analysis. The remaining columns in figure 1 identify the analyses that are dependent on the data from each data source analysis. The dependencies identified in figure 1 may vary depending on the methods that a launch operator chooses to implement to meet the proposed requirements for each analysis. A launch operator would have to understand the dependencies that its analyses have on one another in order to ensure that the overall analysis results accurately reflect the proposed launch and provide for public safety. The following paragraphs provide some examples of these dependencies that are of particular interest.

BILLING CODE 4910–13–P

Data Source Analyses (These analyses provide data to the dependent analyses indicated.)	Dependent Analyses (These analyses use data from the data source analyses indicated.)											
	Trajectory Analysis (§417.205)	Malfunction Turn (§417.207)	Flight Safety Limits (§417.213)	Straight Up Time (§417.215)	No-Longer Terminate Gate (§417.219)	Data Loss Flight Time (§417.221)	Flight Hazard Areas (§417.225)	Debris Risk Analysis (§417.227)	Toxic Release Risk (§417.229)	Distant Focus Overpressure Blast (§417.231)	Conjunction on Launch Assessment (§417.233)	Sub-Orbital Rocket Analysis (§417.235)
Trajectory Analysis (§417.205)		X	X	X	X	X	X	X	X	X	X	
Malfunction Turn Analysis (§417.207)			X	X		X	X	X	X	X		
Debris Analysis (§417.209)			X	X	X	X	X	X	X	X	X	
Flight Control Lines (§417.211)			X	X	X	X	X	X	X	X		
Flight Safety Limits (§417.213)					X	X		X	X	X		
Straight-Up Time (§417.215)									X	X		
Wind Analysis (§417.217)	X		X	X	X	X	X	X	X	X		X
No-Longer Terminate Gate (§417.219)						X		X	X	X		
Time-Delay Analysis (§417.223)		X	X	X	X	X	X	X	X	X	X	
Flight Hazard Areas (§417.225)								X				
Sub-Orbital Rocket Analysis (§417.235)								X	X	X	X	

Figure 1

BILLING CODE 4910–13–C

All of the analyses depend on some form of trajectory analysis. Before a launch operator can analyze malfunction turns, establish flight safety limits or hazard areas, or perform various risk analyses, the launch operator must have a clear understanding of what the launch vehicle's trajectory would be under normal conditions when the vehicle performed as intended. For example, a launch operator would employ a point along the nominal trajectory as a starting point for a malfunction turn. As another example, in order to establish flight control lines and any gates in a flight control line that define the region over which a launch vehicle would be allowed to fly, a launch operator would have to know the limits of normal launch vehicle flight. The other proposed analyses have a similar dependence on the results of the trajectory analysis. An error made when performing the trajectory analysis or in translating the output of the trajectory analysis into input for the other analyses, can have a ripple effect, resulting in invalid analysis results with a potential negative effect on public safety.

Before a launch operator can establish flight safety limits or hazard areas to protect people and property from flight hazards, the launch operator must have a clear understanding of those hazards, which is the primary purpose of the debris analysis. A launch operator would conduct a debris analysis to identify inert, explosive and other hazardous launch vehicle debris resulting from a launch vehicle malfunction and from any planned jettison of launch vehicle components. A debris analysis would list and categorize the debris that would result from planned events and the potential activation of a flight termination system or spontaneous breakup due to a launch vehicle failure. Each debris piece would be categorized according to its physical properties and other characteristics, such as whether it is inert or explosive and the effects of impact, such as explosive overpressure radius, skip, splatter, or bounce. A launch operator 's flight safety limits analysis and hazard area analyses would use the debris characteristics established by the debris analysis to determine the debris impact dispersion, which shows where the debris might travel as it falls through the atmosphere and as it is affected by conditions such as wind and changing air density. The products of the debris analysis would also be used to determine where planned stage impacts would occur and, in the event of a malfunction, to ensure activation of the flight safety system in sufficient time to keep the impacting debris from impacting outside the flight control lines. The hazard area analysis would use debris data to identify the land, sea, and air regions that would have to be publicized, monitored, controlled, or evacuated in order to protect the public from potential impacting debris and comply with the public risk criteria.

As a final example, the debris analysis products would be employed in a debris risk analysis to determine the expected average number of casualties (E_C) to the collective members of the public exposed to inert and explosive debris hazards from any one launch. The calculation of E_C is dependent on the effective casualty area of the debris. A debris risk analysis would determine the effective debris casualty area as a function of, among other factors, launch vehicle flight time, whether the debris is from a launch vehicle breakup or a planned spent stage or jettisoned component impact, and whether the debris is inert or explosive on impact or dissipates through burning during its fall. A launch operator's debris analysis would also determine the effective casualty area for debris resulting from both payload and vehicle systems and subsystems.

8. Casualty Due to Debris

A launch operator should be aware that a debris analysis raises issues that have been the subject of debate for some time with respect to the definition of casualty. By this notice, the FAA proposes to employ its definition of serious injury as part of its definition of casualty. The FAA defines serious injury to mean any injury which requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; results in a fracture of any bone (except simple fractures of fingers, toes, or nose); causes severe hemorrhages, nerve, muscle, or tendon damage; involves any internal organ; or involves second- or third-degree burns, or any burns affecting more than five percent of the body surface. *See* 14 CFR 401.5 (referencing ''serious injury'' within definition of ''launch accident'').

The proposed debris analysis requirements would require a launch operator to identify each piece of debris. In determining the debris hazard area that constitutes part of a flight hazard area and in defining ship-hit contours, the proposed regulations would require a launch operator to account for debris pieces with a ballistic coefficient of three or greater. The FAA realizes that, depending on circumstances, the impact of a person by a debris piece with a ballistic coefficient of less than three might cause a casualty and conversely, a debris piece with a higher ballistic coefficient might not cause a casualty. However, based on a review of the approaches used at the federal launch ranges, the FAA believes that using a ballistic coefficient of three when determining hazard areas and performing debris risk analyses provides for an appropriate level of safety.

The Western Range has historically analyzed all debris, regardless of how small the debris may be. The Eastern Range uses a ballistic coefficient of three as the measure of concern. The FAA proposed a ballistic coefficient of three in its Launch Site NPRM. A ballistic coefficient of three correlates approximately to a hazardous debris piece possessing 58 foot-pounds of kinetic energy, the Air Force explosive safety standard for debris that would produce a casualty. ''Casualty Areas from Impacting Inert Debris for People in the Open,'' RTI/5180/60–31F Montgomery and Ward, 2.2 (Apr. 13, 1995). This report recognizes the difficulties in establishing a suitable threshold expressed in terms of kinetic energy. *Id.* (citing ''Estimation of Casualty from Impacting Debris,'' ACTA, Inc., Technical Rep. No. 39–217/15–01, prepared for the U.S. Department of the Air Force (Sept. 29, 1989)). Those difficulties may be illustrated through example. For instance, a tackled football player who experiences an energetic impact of 400 to 500 foot-pounds usually is not injured. On the other hand, someone who stops a 38-caliber bullet having a kinetic energy of only 120 foot-pounds may well be killed. Other difficulties in employing kinetic energy as an indicator of a hazard are apparent as well. A piece of launch vehicle debris with an area of one square foot and a tumbling ballistic coefficient of two can have a vertical velocity component at impact of about 21feet per second and a kinetic energy of about eight foot-pounds. Although a broad side impact from the debris piece might leave a person unharmed, a slashing end-on impact might result in a serious wound.

Accordingly, although the Air Force uses 58 foot-pounds as a safety standard for a hazardous debris fragment , the FAA does not consider 58 foot-pounds a sufficiently adequate measure of what might produce a casualty. ACTA points out that this impact energy could be obtained with a full 12-ounce beverage can dropped from seven stories up, and that it could kill someone at street level. ''Estimation of Casualty'' at 1–10. Nor does reliance on kinetic energy account

for the surface area over which the impact may occur, or the duration of the impact, both of which are significant.

As a result, as the FAA proposed in the Launch Site NPRM, the FAA proposes to rely on a ballistic coefficient of three. See Launch Site NPRM, 64 FR at 34347 (relying on ballistic coefficient of three ''because it is the most wind sensitive debris piece with a potential for harm of reasonable significance.'').

9. Collective Risk

As in previous rulemakings, this rulemaking raised a number of issues regarding risk. The FAA has had to address whether or not to limit risk based on an aggregation of the risks associated with each common launch hazard, whether to set a risk limit for each hazard separately and questions regarding the contribution of a flight termination system failure to risk in the launch area. The FAA proposes to limit acceptable risk to an aggregation of all hazards. On the basis of practices at the federal launch ranges, the FAA proposes to require consideration of the possibility of a flight termination system failure as a contributor to the risk of debris.

a. *Aggregation of hazards to measure risk.* In 1999, the FAA adopted a risk standard for debris which permitted launch only if flight of the launch vehicle did not exceed an expected average number of 0.00003 casualties (E_C) per launch ($E_C \leq 30 \times 10^{-6}$). 14 CFR 415.35(a). In this notice the FAA proposes to set a collective risk standard that accounts for all hazards, not just for debris, including such common hazards as those associated with toxic releases and blast overpressure. As permitted by 127–1, different federal launch ranges have different practices. EWR 127–1 establishes launch risk guidance on ''a collective risk level of not more than 30 casualties in 1 million (30×10^{-6}) for the general public.'' EWR 127–1, 1–12, 1.4d (Oct. 31, 1997). The Air Force has not made a final decision on what that measure reflects. *See id.* at 1–41, Appendix 1D, 1D.1b (''The overall risk levels *may or may not* be an additive value that includes risks resulting from debris, toxic and blast overpressure exposures.'' (Emphasis added.)) In practice, this has resulted in differing approaches at the Eastern and Western Ranges.

Historically, the 30th Space Wing, which oversees safety at the Western Range at VAFB, has reviewed an aggregated E_C for all hazards of each launch when the measures of risk for each hazard are available.[6] The Western Range has found that one hazard usually predominates as the source of risk. The conditions that are conducive to driving up the risk of one hazard usually render another hazard less significant. Also, as a general rule, most launch vehicles do not generate multiple risks. Accordingly, on the basis of available risk measures, at the Western Range, the risks created by the combination of debris, toxic releases and blast overpressure do not tend to exceed $E_C \leq 30 \times 10^{-6}$.

The same may or may not be true at the Eastern Range. The 45th Space Wing, which conducts launch safety for the Eastern Range, came more recently to the use and quantification of risk. Weather conditions and launch azimuths did not require the refinements of risk analysis to determine when conditions were satisfactory for launch. The Eastern Range used deterministic methods predicated on worst case conditions, assuming for toxic hazards that the undesired event would occur. Unlike the Western Range, the Eastern Range does not aggregate the risk numbers associated with each hazard for each launch. Instead, it caps two hazards, debris and overpressure, at $E_C \leq 30 \times 10^{-6}$, and possibly toxic hazards as well. Were the Eastern Range to limit an aggregate of the identified hazards, rather than each one, the Eastern Range believes that launch availability would be curtailed below present launch rates. Accordingly, for commercial and government launches, the Eastern Range uses an $E_C \leq 30 \times 10^{-6}$, for debris, an $E_C \leq 30 \times 10^{-6}$ for blast overpressure and $E_C \leq 233 \times 10^{-6}$ for toxic releases, where the Eastern Ranges defines the public as non-mission essential personnel located at the Cape and the general public outside of the Cape. The E_C for toxic releases reflects the fact that the Eastern Range operates within the Range Commander's discretionary zone for accepting risk. The FAA foresees the possibility that capping risk at an $E_C \leq 30 \times 10^{-6}$, for all hazards, may have an impact on launch availability and scheduling and invites comment from the launch operators regarding any data they may have regarding the possible effects.

[6] As the FAA is proposing, the federal launch ranges assess risks to determine the acceptability of those risks when containment or exclusion measures do not otherwise provide an adequate approach. Exclusion has proved practical and therefore, often, preferable. Where the ranges employ exclusion, they often do not measure the risk because risk remains far below the threshold levels. For example, if there is no inversion layer on the day of launch, there is no need to perform a risk analysis.

The accuracy of the Eastern Range's measure of expected casualty is the subject of debate in light of the mitigation response available. In accordance with guidance from Space Command's Surgeon General, the Eastern Range approached local Brevard County authorities, described its risk management policy to the county and recommended a hazard level and management approach. The county agreed to the approach. The Eastern Range informed the county of its nominal public safety criteria of 30×10^{-6} for each hazard, but that the recommended concentrations and risk level represented a collective risk level of 233×10^{-6}. The county agreed with the recommendation. The Eastern Range and the county reached agreement on what predicted concentration of parts per million for various substances would result in a launch delay. The Eastern Range has not developed any methodology by which the effectiveness of Brevard County's emergency response can be accounted for in its risk estimation model, LATRA.

The county and the Eastern Range improved their notification capability after a January 1997 Delta abort, which took place prior to county personnel being present on base for all launches. Notification to the Brevard County Emergency Management Coordinator about the actual abort hazards from the August 1998 Titan abort took only minutes, as opposed to hours for 1997 Delta abort. Additionally, since that time the county has activated its automated reverse 911 capability for calling thousands of residences per hour for emergency notifications. While this capability has not been exercised to date for hazards arising out of a launch, it certainly promises mitigation benefits. Also, arrangements between Brevard County emergency management personnel and National Weather Service (NWS) Melbourne weather personnel have been made to transmit emergency management announcements of toxic cloud information. The announcements are made over the NOAA Weather Alert Radio System, which is constantly monitored on thousands of radios throughout the county, particularly at all schools and other county facilities. These emergency response capabilities and their effectiveness in reducing overall risk of exposure have not been evaluated.

Maintaining all risks below an acceptable level provides the best course. The FAA seeks to avoid a person being injured by any cause. This constitutes current practice for the 30th Space Wing and may well prove to constitute current practice for the 45th

Space Wing. The 45th may continue to abide by its understanding with Brevard County and alert the county at the concentration levels agreed to for government launches. The FAA anticipates that part of achieving a common approach to aggregations would require a launch operator to input identical failure response modes and associated probabilities for each hazard. If, for a commercial launch, risk exceeds 30×10^{-6} when calculated under a standardized approach, launch may not take place. The FAA seeks public comment on the potential impacts of this proposal.

b. *Contribution to collective risk due to the possibility of flight termination system failure.* The FAA proposes to require a launch operator to address the possibility of a flight termination system failure in the course of the launch operator conducting its risk analysis. Although it may appear that flight termination system contribution is not addressed for most operational systems launching from federal ranges today, the ranges do, in fact, review whether flight termination system failure may constitute a significant contribution to risk. The ranges make this assessment early in the process of assessing a new launch vehicle system, and the Eastern Range, for each launch, assesses failure modes where a potential flight termination system failure could result in significant contribution to collective risk. Because of the robust flight termination system test program, redundancy and the degree of oversight the ranges' flight safety system analysts exercise, those responsible for assessing risk count on the reliability of the flight termination system employed for each launch. Although in many instances initial analysis may demonstrate that the contribution of flight termination system failure to expected casualty is insignificant, a credible scenario may exist where the contribution would be significant. Accordingly, based on the ranges' experience and the reasons addressed in the following discussion, the FAA proposes to ensure through this rulemaking that all commercial launch operators employing a flight termination system account for the contribution to risk of possible flight termination system failure.

As a general rule, where a flight termination system plays a role in mitigating a hazard, the likelihood of a failure of a flight termination system may contribute to the final outcome of an E_C analysis and the ranges assess that contribution to determine its significance. Where a flight termination system does not serve to mitigate the potential risk, its contribution is not assessed. With the exceptions of failure scenarios addressing toxic and distant focus overpressure hazards, this typically means that for failure scenarios in which the launch vehicle's instantaneous impact point remains within the range destruct lines, possible flight termination system failure does not contribute in a significant way to risk totals. This is because under those circumstances the consequences of such a failure remain extremely low. A flight termination system may fail while the launch vehicle performs successfully, or the launch vehicle and the flight termination system could both fail, but if the launch vehicle's instantaneous impact point stays within the destruct lines, the consequences are typically negligible.

For potential launch vehicle break up that occurs when the vehicle's instantaneous impact point has moved outside the range destruct line, the ranges consider flight termination system reliability a factor in debris, toxic and distant focus overpressure E_C calculations because a flight termination system can prevent a launch vehicle from crossing destruct lines. The Western Range generally does not calculate the E_C for vehicle instantaneous impact point outside the destruct lines for each launch. At the Eastern Range, the 45th Space Wing does account for the possibility of a launch vehicle's instantaneous impact point crossing destruct lines, in what it characterizes as a ''mode 5'' failure analysis, due to the presence of populations in the vicinity including launch viewing areas open to the public.

There are also scenarios where the vehicle's instantaneous impact point remains within the destruct lines and where potential flight termination system failure would contribute to collective risk. For example, an on course failure endangering the continued operation of the flight termination system itself, by, for example, tumbling, could contribute to risk, although the ranges do not consider it significant because of the flight termination system design and test requirements that ensure a flight termination system will survive launch vehicle failure environments to the point that the launch vehicle will break up. As another example, if a flight termination system failed to disperse toxic materials at altitude or prevent intact impact of propellant and resulting explosions, the flight termination system probability of failure might contribute to risk.

Toxic release and distant focus overpressure risks are both functions of the probability of vehicle breakup at a location near the launch site and their hazardous effects upon the public are not necessarily dependent on destruct line violation. Therefore, destruct line violation is not considered as a factor in calculating toxic release and distant focus overpressure risks.[7]

F. Flight Safety System

1. Introduction

This proposed rulemaking contains requirements governing a flight safety system. The FAA proposes to define a flight safety system as a system that provides a means of preventing a launch vehicle and its hazards, including any payload hazards, from reaching any populated or other protected area in the event of a launch vehicle failure. A flight safety system, unless otherwise approved in the course of the licensing process, consists of an onboard vehicle flight termination system, a command control system, and support systems on the ground, including tracking, telemetry, display, and communications, and includes all associated hardware and software. A flight safety system also includes the functions of any personnel who operate flight safety system hardware and software.

This proposed rulemaking reflects much that is current practice at the federal launch ranges today. As with the other proposed requirements, the FAA in this proposed rulemaking intends to regulate flight safety systems as necessary to protect the public health and safety and the safety of property against significant risks and to achieve a high level of safety. A flight safety system protects against the significant risks created by launch of a launch vehicle. The requirements of the federal launch ranges, including their design, testing and installation requirements, are all part of an approach that has resulted in members of the public experiencing no physical harm. The FAA seeks to maintain the same high level of safety that the federal ranges have achieved. At the same time, the

[7] At the Eastern Range, only debris is considered for possible E_C contribution outside of a destruct line. Failure of a flight termination system could allow an intact vehicle to impact off site with enough remaining toxic or perhaps explosive material to cause a toxic release or explosion at the distant site. To employ the ranges' computer models for a risk analysis under this situation would require establishing a source location at the distant impact site and assessing the local population, number of windows, local wind field, etc. This is not practical given a large number of possible, random distant impact sites. Because a flight termination system failure with ensuing uncontrolled flight and impact would be hazardous enough in itself, the Eastern Range treats attempting to calculate additional secondary effects of toxics and overpressure as superfluous.

FAA recognizes that more than one method exists by which to protect the public and to achieve the requisite levels of safety.

The proposed rulemaking proposes performance requirements for any flight safety system a licensed launch operator will employ, whether that flight safety system is the more familiar command destruct system, or an autonomous system, including Sea Launch's Russian and Ukrainian thrust termination system. As one of the more general performance goals, a flight safety system must keep the hazards associated with a launch vehicle and its payload from reaching populated and other protected areas. A launch operator seeking a license must demonstrate convincingly its ability to satisfy this requirement. If a launch operator plans to employ the flight termination system upon which most licensees rely today, this proposed rulemaking provides the performance, design, test and installation requirements with which that licensee must comply. If a launch operator proposes an atypical flight safety system, the launch operator must provide a clear and convincing demonstration that it will achieve an equivalent level of safety to that obtained through adherence to the requirements.

Although this proposed rulemaking would codify much of what the federal launch ranges require, some changes will be evident. Some of these changes arise out of the differences between regulatory requirements and the fact that the federal launch ranges may speak in terms of goals and the FAA must determine whether to require that goal or not. Other differences will evolve out of the existence of waivers issued by the federal launch ranges. A review of some of the background behind various flight safety systems is useful at the outset.

2. History and Background

Launch vehicles launching from the United States typically use a flight safety system, referred to at the federal launch ranges as a flight termination system or FTS, that is used to destroy the launch vehicle whenever the launch vehicle strays outside of a predefined flight envelope. Federal launch ranges typically require an FTS on guided launch vehicles that have the capability to violate established safety criteria under powered flight, in order to protect the public and range personnel. The reliability of the flight safety system plays more of a role than the reliability of the launch vehicle in achieving safety.

U.S. design standards normally require a redundant command flight termination system on every powered stage capable of reaching the public unless a particular stage possesses an autonomous destruct system such as an inadvertent separation destruct system (ISDS). The commonly employed inadvertent separation destruct system is usually implemented for solid rocket motors. Some rocket stages, primarily solid rocket boosters, may be capable of continued flight after becoming separated from the main launch vehicle if their propellant is not exhausted and continues to burn or even, as happens at times, begins to burn and produce thrust. An ISDS is required to ensure that a thrusting motor, freed by a vehicle breakup, will be destroyed. An ISDS uses lanyards, break wires, or other devices to detect the conditions in which it will initiate a destruct action. An ISDS is typically employed on stages that have the potential to become separated from the command flight termination system during the break up of a launch vehicle.

An autonomous system such as Sea Launch's Zenit-3SL's thrust termination system uses multiple computers to evaluate vehicle status as well as vehicle performance to determine if a flight termination command is required. The U.S. standards require a flight termination system to destroy a vehicle, not just terminate the motor thrust as is accomplished by a thrust termination system. An U.S. flight termination system is designed to terminate the thrust of the vehicle and to disperse the propellants with minimal explosive effect. Russian and Ukrainian space launch programs traditionally use an autonomous thrust termination system for liquid fueled vehicles. Such a system relies on the autonomous detection of trajectory or vehicle anomalies, the detection of which results in an autonomous shutdown of the liquid rocket engines. Termination of thrust allows an errant rocket to fall ballistically back to Earth. This approach tends to confine the damaged region on the earth more than mid-air destruction of the launch vehicle; however, the resulting intensity of the destruction may be more pronounced if a thrust termination system shuts down and leaves propellants in a vehicle's tanks, and the tanks survive until impact.

Although the federal launch ranges typically require a command flight termination system on the final powered stage capable of reaching the public, some U.S. launch vehicles, including the Scout and Pegasus, have previously been approved, through federal launch range waiver processes, for launch without a flight termination system on the final stage. Each vehicle provides a command hold fire capability on the final stage ignition, which means that if the launch vehicle is not on its intended trajectory that the flight safety official can transmit a command for the stage not to ignite. Range approval of these two vehicles resulted from a failure modes and effects analysis that identified all potential failure modes that could result in land impact, and an expected casualty analysis that satisfied the ranges' risk criteria, assuming these failures.

An examination of U.S. launch history shows that flight termination systems have been very dependable. Since the late 1950's there have been about ten flight termination system failures in approximately 3150 launches, resulting in a demonstrated flight termination system reliability of 0.996 at 95% confidence. The ten failures include both ground system and failures of the system located on the launch vehicle. In most of these failures, the flight termination system was not required to initiate a destruct action, but the flight termination system was declared ''failed'' because it would not have worked if it had been required at some point in its flight. This demonstrated reliability compares favorably to the federal launch range goal of 0.998 reliability at 95% confidence for the complete ground and airborne system. 45th Space Wing/Eastern Range Range Safety Operations Requirement Command Destruct System, 7.7.1.2.8 (Apr. 2, 1998); Range Commanders Council Document 319–92, ''Flight Termination System Commonality Standards'' 2.4.1 (Aug. 1992). In the 1960's, three flight termination system in-flight component failures occurred; two were ordnance-train failures and one was an electronic system single-channel failure.

There have been a few isolated instances of anomalies associated with human-commanded flight termination systems. In February 1993, a Pegasus launch of Brasilsat was successful but was marred by poor integration and poor communication between the operators and the personnel responsible for range safety.[8] Although there were no flight termination system component failures, an abort was called because of the dropout of one frame (40 milliseconds) of telemetry data from one of the flight termination system

[8] ''Special Investigation Report, Commercial Space Launch Incident, Launch Procedure Anomaly, Orbital Sciences Corporation Pegasus/SCD–1 80 Nautical Miles East of Cape Canaveral, Florida,'' NTSB (Feb. 9, 1993).

command receivers. The federal launch range required the vehicle's flight termination system to be fully functional for launch to occur. Due to lack of proper operational preparation and operational coordination between the range safety personnel and the operational controllers, the range safety call for abort was not acknowledged, and the launch proceeded. Despite this incident, the launch vehicle flew nominally and successfully orbited its payload.

In October 1995, a Conestoga launch from Wallops Flight Facility experienced a flight termination system anomaly. Although the vehicle broke up due to aerodynamic forces caused by a malfunction that induced a yaw, an attempt was made to issue a destruct command. The failure occurred at the exact time the command routing was being switched from one ground station to another, and it is questionable whether the command was actually sent. Frequency monitoring determined that the signal was not transmitted. The vehicle's seven solid rocket boosters should have been split down the side by their ISDS to destroy their flight capability. However, at least two of the boosters continued to fly unguided. Although no harm occurred, the flight termination system did not operate as designed.

3. Flight Safety System Reliability

Federal launch range standards require a flight termination system to be designed to function in environments that exceed normal environments expected during flight in order to ensure launch vehicle destruction following a failure. U.S. flight safety system components are required to be independent of vehicle systems and withstand a harsher environment than other launch vehicle components. The federal launch ranges have a reliability goal of a minimum of 0.999 at the 95% confidence level for the flight termination system onboard a launch vehicle. EWR 127–1 at 4.7.3.1(a). RCC Flight Termination System Commonality Standards at 2.4.1. A 0.999 reliability at a 95% confidence level can only be demonstrated through a large number of launches or tests of the complete system while exposed to flight environments. Because it is not practical to test systems in the numbers necessary to demonstrate this confidence level, the federal launch ranges employ robust testing of the individual flight termination system components and testing of the integrated system that is designed to identify problems that could lead to system failure. This test program incorporates the lessons learned over the many years of federal launch range operations and represents the industry's best practice for ensuring the reliability of such a system. Additionally, the command control system that transmits any flight safety commands to the onboard vehicle system also has a reliability goal of 0.999 at 95% confidence. This results in an overall federal range flight safety system reliability goal of 0.998 at 95% confidence. The federal ranges have been very successful in implementing their reliability goal as a goal rather than as a requirement. However, such a goal does not directly translate into a regulatory requirement. The FAA's proposed regulations would require each flight termination system and command control system to have a reliability design of 0.999 at a confidence level of 95 percent to be demonstrated through an analysis of the design. The FAA is not proposing that this reliability be demonstrated through testing because it is not practical to require the thousands of system level tests necessary to demonstrate compliance with the confidence level. Instead, the FAA is proposing an approach that has been developed in close coordination with the federal launch ranges that incorporates performance oriented design requirements for components coupled with comprehensive qualification and acceptance testing of components and preflight confidence tests of the entire system to ensure the system's reliability.

4. Flight Termination System Testing

The proposed regulations contain requirements for qualification and acceptance testing of flight termination system components based on the approach used at the federal launch ranges. At federal launch ranges, flight termination system components are tested according to federal range-approved test procedures and requirements. Verification methods include test, analysis, and inspection. As an alternative to testing, components of an FTS are sometimes qualified by similarity. A component that has been qualified through testing for one launch vehicle may be approved for use on a different launch vehicle if it can be shown that the environments in which it must operate on the second vehicle are no harsher than those of the first. Also, with limited additional testing, the component may be qualified for a more severe environment.

The flight safety system component manufacturers or vendors at their facilities typically perform qualification and acceptance tests. Qualification tests are performed to verify the design of a flight safety system component and to demonstrate that it will operate reliably at design margins that are greater than the environments to which the component will be exposed. In general, the test program requires qualification testing at levels twice the maximum predicted environment to which the flight termination system would be exposed during storage, transportation, handling, and flight. Functional and electrical tests are performed before and after each environmental test. Typical U.S. qualification test levels and tests include sinusoidal vibration, random vibration, acoustic, shock, thermal cycling, thermal vacuum, and functional tests. Units that undergo qualification testing are not used in flight. Each unit a vendor produces for actual flight undergoes acceptance testing. Acceptance tests provide quality-control assurance against workmanship or material deficiencies and demonstrate the acceptability of each item before flight. Acceptance testing is typically performed on all flight units at levels equal to the maximum predicted environment. Typical acceptance tests include acoustic, acceleration, thermal cycling, and random vibration. Electrical components to be used for flight typically are acceptance tested while single use components such as ordnance and some types of batteries are accepted for flight by performing destructive tests on a number of sample components taken from the same production lot as the component that will be flown.

Preflight confidence tests are conducted at the launch site in the form of bench tests of components and system level tests once the components are installed on the launch vehicle. For example, preflight bench tests are performed on a flight termination system receiver decoder after it arrives at the launch site. These tests are conducted to ensure the receiver decoder is compatible with range ground equipment and operational characteristics have not changed since they were acceptance tested by the vendor. These preflight tests are conducted before and after installation of the flight termination system in the launch vehicle, and before final approval for launch is given. Preflight system testing demonstrates the integrity of the entire system, including transmitters, antennas, receiver decoders, flight power supplies, vehicle engine shutdown valves, and vehicle flight termination system circuitry.

5. Tailoring

The federal launch ranges may ''tailor'' their flight termination system design and test requirements to fit a specific launch vehicle application. The tailoring is intended to ensure that only applicable or alternative range user requested equivalent requirements are levied upon the program and that range safety requirements are levied in the most efficient manner possible. Meets Intent Certification, a form of range tailoring, may be used when a launch operator does not meet the letter of the EWR 127–1 requirements but meets the intent of the requirements. The FAA proposes that a type of tailoring take place during the licensing process. The proposed regulations would allow a launch operator to meet the intent of a requirement through alternative means that provide an equivalent level of safety. Once approved during the licensing process, use of an alternative would be part of the terms of the license. Once licensed, if a launch operator wished to implement a new alternative, it would do so by applying for a license modification.

6. Deviations and Waivers

A federal launch range may grant deviations and waivers when a launch operator does not meet EWR 127–1 requirements. EWR 127–1 permits deviations and waivers when the mission objectives of the range user cannot otherwise be achieved. Deviations are used when a flight termination system design noncompliance is known to exist prior to hardware production or an operational noncompliance is known to exist prior to beginning operations at a federal launch range. Waivers are used when, through an error in the manufacturing process or for other reasons, a hardware noncompliance is discovered after hardware production, or an operational noncompliance is discovered after operations have begun at the ranges. Unlike Meets Intent Certification, the latest EWR 127–1 contemplates acceptance of greater risk for both deviations and waivers. Under the federal launch range process, a launch operator may obtain a deviation or a waiver to meet mission requirements. By implication, this involves an acceptance of greater risk. A launch operator under the proposed regulations would have to demonstrate an equivalent level of safety if it wanted to avoid a published requirement. This is in keeping with the FAA's current practice for licensed commercial launch, but may mark a change from current practice for some who are accustomed to conducting government launches.

7. Alternate Flight Safety Systems

A flight safety system would be required to satisfy all the functional, design, and test requirements of proposed subpart D of part 417 unless the FAA approved otherwise through the licensing process. The FAA would approve the use of a flight safety system that did not satisfy all of proposed subpart D if a launch operator demonstrated that the proposed launch achieved a level of safety equivalent to satisfying all the requirements of proposed subpart B and proposed subpart D. In such cases, a launch operator would have to demonstrate that the launch presented significantly less risk than would otherwise be required, both in terms of E_C and any other significant factors underlying a risk determination. The reduced level of public risk would have to correspond to the reduced capabilities of the proposed flight safety system. To achieve the reduced level of public risk, the launch would typically have to take place from a remote launch site with an absence of population and any overflight of a populated area taking place only in the latter stages of flight. The proposed alternate flight safety system would have to perform its intended functions, however they might differ from the requirements of subpart D, with a reliability comparable to that required by subpart D.

To date, one launch operator has demonstrated this equivalent level of safety to the FAA for an alternate flight safety system. Sea Launch Limited Partnership, which the FAA has licensed to launch from the Pacific Ocean, satisfied the required conditions. The FAA concluded that Sea Launch proposed to employ a flight safety system that, although substantially different from its American counterparts in function, was of comparable reliability. Sea Launch's first launch, for example, presented less risk than otherwise required of a typical launch because of a conservatively calculated E_C of noticeably less than 30×10^{-6}, a launch location barren of population and overflight that took place only in the latter stages of flight.

The design and testing of the Sea Launch thrust termination system were not conducted in accordance with subpart D due to the development of the thrust termination system under foreign auspices. Although many similarities between the two systems in design, redundancy requirements and testing were evident, there were pronounced differences as well.

Sea Launch's flight safety system functions differently than one that satisfies the requirements of subpart D. Unlike an American command destruct system, Sea Launch's flight safety system terminates flight by autonomously terminating thrust without destroying the launch vehicle. The FAA's proposed requirements, like those of the federal launch ranges, would require a flight termination system to destroy a vehicle in order to reduce, if not eliminate, the potential for explosive effects upon debris impact. Sea Launch does not possess the capability to command flight termination from the ground. Additionally, where a U.S. flight termination system provides the ability to avoid terminating flight when an instantaneous impact point is over land, the thrust termination system did not.

Likewise, the FAA reviewed the test procedures, test levels, and maximum predicted environments for the thrust termination system components and compared them to U.S. federal launch range test requirements. Were the Sea Launch thrust termination system held to the requirements proposed in subpart D of part 417, not all requirements would apply and not all were satisfied. As expected there were differences in test requirements between the U.S. and Sea Launch's partners, Yuzhnoye and Energia. The Sea Launch experimental development tests were similar to U.S. qualification tests in that both forms of testing subjected hardware not used for flight to levels greater than maximum predicted environment for design verification. The thrust termination system's experimental development tests, however, were not typically conducted to twice the maximum predicted environment, as done for U.S. qualification tests. Additional differences appeared in Sea Launch's equivalent of acceptance testing. Although Sea Launch tested its flight units, it did not test them to the predicted flight environment.

The flight heritage of the many Russian and Ukrainian launches provided a measure of design verification for the Zenit-3SL rocket stages and thrust termination system components. The Zenit-3SL thrust termination system is based on heritage hardware and software used successfully for decades in launches conducted by the former Soviet Union. Accordingly, Sea Launch's use of a thrust termination system is not akin to the use of an untested or otherwise non-compliant flight safety system, or even to one with a very limited flight history.

Sea Launch also showed that, although its flight safety system did not

possess all the functional capabilities required by subpart D, those capabilities that it possessed instead were of comparable reliability on the basis of vehicle and flight safety system heritage and use. Sea Launch informed the FAA that the thrust termination system had worked each time an errant launch vehicle had to be stopped. The FAA's own review found no evidence to the contrary. Historical thrust termination system performance data indicated that there have been over 3000 launches with an automated thrust termination system. Of these flights, 370 failed to achieve their mission objective. Of these 370 mission failures, 110 resulted in errant launch vehicles and Sea Launch reported that the thrust termination system functioned properly in all 110 cases. The FAA conducted an analysis as well. In the end, a combination of analysis, testing and use provided a demonstration of comparability.

The FAA did not base its determination to license Sea Launch solely on finding comparable reliability of the flight safety system. The reduced risk of the proposed flight profile played just as much of a role in the decision. Where the flight safety system presented reduced functional equivalence, the launch operator had to show a corresponding decrease in the proposed risk. Reviewing the risk presented by the Sea Launch mission for its first launch, the FAA concluded that Sea Launch's E_C fell roughly one order of magnitude less than the required E_C of 30×10^{-6}. The FAA employed a conservative reliability number of 0.917 for the Zenit-3SL's upper stage,[9] population densities obtained from the ''General Population Distribution (1990), Terrestrial Area and Country Name Information on a one-by-one degree Grid Cell basis (DB1016),'' Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, TN, the upper stage dwell time over South America and the risk to the command ship. In addition, the FAA's South American overflight risk analysis accounted for both a failure of the launch vehicle and an inadvertent actuation of the thrust termination system.

Certain other factors underlying a risk determination also took on added significance. The Sea Launch flight profile provided advantages that minimized public exposure. The launch vehicle underwent maximum dynamic pressure at about 60 seconds after liftoff, at a point near the launch site that limited public exposure to only those located on Sea Launch's command ship. The command ship was stationed uprange, outside the launch hazard area. This is significant in that historically most launch vehicle failures occur during the first stage of flight, with many occurring prior to or during maximum dynamic pressure. The instantaneous impact points for Sea Launch's first and second stages were over the Pacific Ocean. The FAA also noted that the third stage, the only stage to expose the public to any statistical risk, was subjected to first and second stage flight environments prior to third stage ignition. If a third stage manufacturing defect existed that resulted in a failure, the failure was more likely to occur prior to third stage ignition. This, plus the fact that a majority of third stage failures occur at ignition, would result in third stage failures that produced impacts in the Pacific Ocean. Public risk was also minimized by the remoteness of the SLLP launch location from populated areas. Nearby islands are located west of the launch point, in the opposite direction of flight. Christmas Island, located about 340 km to the west or uprange of the proposed launch location, is the closest inhabited island to the launch location. The only significant populated area within second stage impact range is Hawaii, located several thousand kilometers to the north.

8. Grandfathering

In the course of preparing this proposed rulemaking, the FAA had to confront questions surrounding flight safety system related waivers granted to launch operators by the federal launch ranges. The FAA is aware that this proposed rulemaking may affect a number of launch operators currently operating under range waivers. There may be other waivers of which the FAA is unaware; and the FAA invites comment on the potential impact of those as well. For example, this proposed rulemaking proposes to require that a launch operator employ a flight termination system that will terminate flight in each launch vehicle stage capable of reaching a populated or other protected area. A number of upper stages, including those of Lockheed Martin's Athena and Orbital Science Corporation's Pegasus and Taurus, do not carry an onboard flight termination system. For these vehicles, once the lower stages that contain the flight termination system have separated and the final stage begins thrusting, the range no longer has the ability to terminate flight. For a proposed launch that does not satisfy all of the proposed regulation's flight termination system requirements, the FAA would require the launch operator to demonstrate that the proposed launch achieves a level of safety that is equivalent to satisfying all the flight termination system and risk requirements. This may be accomplished by further isolating the launch from any population as was discussed in the case of Sea Launch. This may or may not be practical for other launch operators. Accordingly, for a launch occurring outside of a federal launch range, the range waiver may not provide grounds for relaxing the FAA's proposed requirements. Instead, each launch would have to be evaluated for an equivalent level of safety on a case-by-case basis.

A review of the available options suggested that the FAA could grandfather these upper stages or require that they comply with the requirements of this proposed rulemaking with an effective date sufficient to prepare for compliance. The consequences differ for each approach, and each possesses drawbacks. If the FAA grandfathers the upper stages in question, launches will continue to take place in which a propulsive stage can carry its hazards to the public. If the proposed requirements are applied to launch vehicles operating under a range waiver, those launch operators currently operating under waivers may experience an increase in costs, have to redesign their upper stages to include a flight termination system, suffer weight penalties, and obtain access to or possibly install command control systems downrange.

Although there are associated costs, the FAA is not persuaded that they are sufficient to outweigh the need to offer the public a high degree of protection. In the course of analyzing the question, the first important factor the FAA had to consider was that, even if one were to apply the federal launch range waiver process, launch from a location outside of a federal launch range might still result in a requirement for a flight termination system on each upper stage. For example, a launch from the East Coast of the continental United States presents different populations at different distances than would a launch from some other part of the country, which means that a risk analysis will produce different results. What satisfies a range risk analysis for Wallops Flight Facility or Cape Canaveral might not for a launch from a non-federal launch site in another part of the country. Additionally, the usual equities that weigh in favor of grandfathering are absent from this situation. Unlike the

[9] The approach results in an overall failure rate almost three times the observed failure rate for the upper stage from all possible causes.

aircraft manufacturing industry, for example, the launch industry builds a new launch vehicle for each use, which permits changes in design more easily than retrofitting a fleet of aircraft. Also, the launch industry adjusts each launch vehicle configuration to some extent to meet the mission requirements for each launch so that a change in safety requirements provides merely one more change to what may be a list of such changes. The FAA is interested in comments on this proposal, both in the context of launches from new launch sites and for launches at current ranges. Should a launch system operating under a federal range waiver be grandfathered under part 417 or be expected to achieve the same level of safety? Does a waiver provide an equivalent level of safety?

G. Ground Safety

This proposed rulemaking addresses ground safety through the imposition of launch processing requirements that would apply both to a launch operator already in possession of a launch license and to an applicant for a launch license. Like the requirements governing flight safety analysis and a flight safety system, an applicant for a license must demonstrate that it will meet the requirements of part 417.

Proposed part 417 would contain ground safety requirements that apply to the preflight preparation of a launch vehicle and related post-launch activities [10] at a launch site in the United States. The Act defines ''launch'' to include not only the flight of a launch vehicle but ''activities involved in the preparation of a launch vehicle or payload for launch when those activities take place at a launch site in the United States.'' 49 U.S.C. 70102(3). Accordingly, the FAA intends to employ the term ''launch processing'' to describe the preparation for flight of a launch vehicle at a launch site. Because the Act gives the FAA licensing authority only over the preparatory activities at a launch site in the United States, the FAA does not seek to impose its requirements under this proposed subpart to launch processing activities that may occur outside the United States.

The ground safety requirements in this subpart would apply to all launch processing activities performed by, or on behalf of, a launch operator. The proposed requirements would attempt to ensure that safety issues unique to launch are addressed, while at the same time avoiding duplication with the requirements of other civilian regulatory agencies.

In addressing the area of ground safety the FAA had to consider, first and foremost, its goal of codifying safety standards that govern the unique issues associated with launch. Secondary to this goal, the FAA faced the question of overlapping jurisdiction between the FAA and the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC). This overlapping jurisdiction raised the question of how much information concerning ground safety the FAA should request in the course of a license application review, and issues regarding the consequences to a launch operator and the FAA in undertaking such a review. As a means of resolving the issues raised by such overlap, the FAA proposes to require that an applicant assess its hazards and institute controls that will keep those hazards from reaching the public.

Some background may be in order at the outset. Most of a U.S. launch operator's launch site experience with federal government safety oversight has taken place at the federal launch ranges. *See* Commercial Space Transportation Licensing Regulations, 64 FR at 19596–597, April 21, 1999. The federal launch ranges are not civilian regulatory agencies but operators of launch sites in their own right. A federal launch range offers its launch site to launch operators for launch. It coordinates and schedules its customers. Its personnel may conduct or participate in hazardous activities. To use a federal launch range, a launch operator must agree to abide by the safety requirements of the range. The federal launch ranges not only impose their own requirements, but also implement the requirements of civilian regulatory agencies such as OSHA, the EPA and others. Accordingly, the requirements that they have developed over the years have combined unique responses to the particular characteristics of launch as well as at the same time responding to the requirements of civilian regulatory agencies. In one sense, the federal launch ranges have stood in for some of these agencies, including the FAA, in ensuring safety through their oversight of the commercial and government contractor launch operators using their facilities.

With respect to ground safety, the FAA proposes to require launch operators to engage in a process derived from principles underlying a system safety process already familiar to the FAA's current licensees, both through their work as contractors for government launches and as users of the federal launch ranges. A launch operator would be required to identify its hazards, assess the risks associated to each of those hazards and implement hazard controls. In light of the existence of regulatory requirements established by the civilian agencies mentioned above, a launch operator will find that many of the hazard controls that a launch operator would have to develop under proposed part 417 are addressed through other regulatory regimes.

The FAA has neither the resources nor the intention of second guessing the regulatory requirements of other agencies nor purporting to issue approvals on their behalf. Under the Act, all requirements of the laws of the United States applicable to the launch of a launch vehicle are requirements for a launch license. 49 U.S.C. 70105(b)(1). The Act also provides, however, that, except as otherwise provided by the requirements of the statute, a launch operator ''is not required to obtain from an executive agency a license, approval, waiver, or exemption to launch a launch vehicle.'' 49 U.S.C. § 70117(a).[11] The FAA may prescribe by regulation that a requirement of a law of the United States not be a requirement for a license, if, after consulting with the head of the appropriate executive agency, the FAA decides that the requirement is not necessary to protect, in relevant part, the public health and safety and safety of property. 49 U.S.C. 70105(b)(2)(C). This rulemaking does not affect the regulatory requirements of other executive agencies.

Other agencies impose similar requirements to those being proposed here. For example, the FAA's proposed requirements strongly resemble a more general version of OSHA's process safety management (PSM) requirements. *See* 29 CFR 1910.119. This means that a launch operator's PSM plan designed to satisfy OSHA's requirements for worker safety may serve the dual purpose, in a number of contexts, of protecting the public as well. The FAA is aware of the confines of the jurisdiction OSHA seeks to exercise ;[12] however, especially in the context of avoiding catastrophic events, what protects worker safety may also protect

[10] Although post-launch ground activities are not licensed, Commercial Space Transportation Licensing Regulations, 64 FR 19586, 19594 (1999), the FAA will exercise its jurisdiction with respect to safety issues arising out of the end of launch.

[11] To date, the FAA has not exercised its exclusive jurisdiction over launch processing at a launch site, relying, for example, on the NRC's licensing of the handling of nuclear materials at federal launch ranges.

[12] ''In the event a standard protects on its face a class of persons larger than employees, the standard shall be applicable under this part only to employees and their employment and places of employment.'' 29 CFR 1910.5(d).

the public, and the FAA proposes to consider such comparisons in the course of the licensing process. If a PSM plan that a launch operator prepares for OSHA contains hazard controls that would protect the public as well, the launch operator need not duplicate the work it does to comply with OSHA's requirements, but may, instead, point the FAA to the portion of the PSM plan relevant to public safety in order to satisfy the FAA's concerns. In reviewing a PSM plan, the FAA would not be opining on the adequacy of the PSM plan for purposes of worker safety.[13]

Likewise, the EPA administers, among other relevant laws, the Emergency Planning and Community Right-to-Know Act, 42 U.S.C. 11001 *et seq.* (EPCRA). That statute applies to facilities where a listed substance is present above a designated quantity, 42 U.S.C. 11002(b), and subjects such a facility, in relevant part, to notification, planning, response and training requirements. *See, e.g.,* 42 U.S.C. 11003, 11004 and 11005.

The NRC regulates and licenses activities involving radioactive materials under the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011–2281. The NRC imposes standards for protection against radiation. *See, e.g.,* 10 CFR part 20. Those regulations prohibit, for example, the release of radioactive materials to unrestricted areas above specified limits and to individual members of the public. 10 CFR 20.1301. Additionally, the EPA possesses generally applicable environmental radiation standards in 40 CFR part 190.

In short, a launch operator needs to be aware of the requirements of these other regulatory agencies and abide by them for launch processing activities at a U.S. launch site and any other location where these agencies have jurisdiction. This discussion focuses on the roles of these particular agencies because much of the safety a launch operator should achieve will be obtained through compliance with the specifics of their regulations. The very broad nature of the FAA's proposed regulations governing preparation for flight of a launch vehicle will obviously encompass much of what these other agencies already address. The FAA anticipates that during the course of pre-application consultation and the license application process itself, the FAA and an applicant will be able to review the nature of the applicant's proposed activities. The applicant will be able to explain and the FAA ascertain whether the launch operator's activities are of such a nature and scope as to fall within the ambit of these other agencies, and, if they do not, the applicant will provide a convincing demonstration to the FAA as to how it will satisfy part 417's requirements.

The ground safety application requirements of part 415 are intended to demonstrate that an applicant can and will satisfy the requirements of part 417. Part 417 requires a launch operator to perform a ground safety analysis. Part 415 asks for a ground safety analysis report. To satisfy the part 417 requirement for ground safety analysis, a launch operator would identify each potential public hazard, any and all associated causes, and any and all hazard controls that a launch operator would implement to keep each hazard from affecting the public. A launch operator's ground safety analysis would be required to demonstrate whether its launch vehicle hardware and launch processing present hazards to the public. The part 415 license application requirement would require an applicant to submit a more abbreviated ground safety analysis report that would review each launch related system and operation and identify potential public hazards and the controls to be implemented to protect the public from each hazard. This report would be required to describe each system and operation and show that all associated public hazards have been identified and controlled and would identify supporting documentation. The FAA might, in the course of the application review or in the course of compliance monitoring, ask to review all or parts of the supporting documentation that provides further detail on a ground safety analysis.

Part 415 would also require a launch operator to submit to the FAA a ground safety plan. A ground safety plan would specify the ground safety rules and procedures that a launch operator would implement to protect public safety. This plan would describe implementation of the hazard controls identified by an applicant's ground safety analysis and the specific ground safety requirements provided in subpart E of part 417. The difference between a ground safety analysis report and a ground safety plan is that the ground safety analysis report would describe the hazard controls and the ground safety plan would describe how hazard controls would be implemented. A ground safety plan would, for example, provide the location of safety clear zones and hazard areas and describe verification processes and the safety equipment and support requirements for each task that creates a hazard to the public.

In addition to the flight and ground safety plans, part 415 would require a series of other launch safety plans as well. These would include an emergency response plan, an accident investigation plan, a launch support equipment and instrumentation plan, a configuration management and control plan, a communications plan, a frequency management plan, a security plan, a public coordination plan, local plans and agreements, test plans, countdown plans, launch abort or delay recovery plan, and a license modification plan.

As discussed earlier, other agencies may also regulate in some of these areas. For example, the accident investigation plan requirement may be satisfied by using accident investigation procedures developed in accordance with the requirements of OSHA at 29 CFR 1910.119 and 120, and the EPA at 40 CFR part 68, to the extent that the procedures include the elements required by part 417.[14] OSHA's standard at 29 CFR 1910.119 includes provisions for investigating incidents and emergency response. *See* 29 CFR 1910.119(m) and (n). In addition, 29 CFR 1910.120, which addresses hazardous waste operations and emergency response (HAZWOPER), provides for emergency response planning for operations involving hazardous materials, including those listed by the Department of Transportation under 49 CFR 172.101.[15]

EPA's requirements at 40 CFR 68 also include standards for incident investigation and emergency response. *See* 40 CFR 68.60, 68.81, 68.90, and 68.180. Compliance with 42 U.S.C. 11003, Emergency Planning and Community Right-to-Know, may satisfy many of the emergency response provisions.

Part 417 would contain the requirements governing the safety of a launch operator's launch processing activities themselves. A launch operator would be responsible for the safe conduct of preflight preparation of its launch vehicle at a launch site in the United States and related post-launch

[13] On a related topic, a launch operator may anticipate that the extent of its utilization of the system safety concepts inherent in such approaches as PSM may affect the FAA's maximum probable loss determination for financial responsibility under 14 CFR part 440.

[14] The EPA's requirements in 40 CFR 68 apply to ''incidents which resulted in, or could reasonably have resulted in a catastrophic release.'' 40 CFR 68.60(a). OSHA's requirements in 29 CFR 1910.119 are similar, applying to ''each incident which resulted in, or could reasonably have resulted in a catastrophic release of a highly hazardous chemical in the workplace.'' 29 CFR 1910.119(m)(1).

[15] The FAA's commercial space regulations, section 401.5, define hazardous materials as those defined in 49 CFR 172.101.

activities. Subpart E of part 417 would contain the requirements for how a launch operator should perform a ground safety analysis, implement hazard control procedures and system hazard controls, define and implement a safety clear zone for hazardous operations, define hazard areas where public access is limited, implement hazard control procedures after a launch or a launch attempt, and would contain the requirements governing propellants and explosives.

The ground safety analysis would serve as the basis for much of a launch operator's license application and for the development and implementation of hazard controls for its launch processing activities. The requirements governing the ground safety analysis would differentiate between hazards on the basis of whether they are public hazards, launch location hazards, employee hazards, and whether they are credible or not.

The hazard category would drive the nature of the controls that must be employed to protect the public. A public hazard would mean any hazard that extends beyond the launch location under the control of the launch operator. Any system that poses a public hazard would be required to be single fault tolerant to protect against the initiation of a hazardous event that could affect the public. A launch location hazard would mean any hazard that extends beyond individuals performing a launch operator's work, but that stays within the confines of the location under the control of the launch operator. A launch location hazard may also affect the public depending on the public access controls employed. Public hazards and launch location hazards include blast overpressure and fragmentation resulting from an explosion, fire and deflagration, and the sudden release of hazardous materials into the air, water or ground, and inadvertent ignition of a propulsive launch vehicle payload stage or motor. Additional launch location hazards that may affect the public when the public is allowed access include oxygen deficient environments, unguarded electrical circuits or machinery, and fall hazards. A launch operator would be required to implement hazard areas and safety clear zones for public hazards and launch location hazards to ensure that any member of the public is kept at a safe distance. A launch operator may elect to treat its entire launch location as a safety clear zone at all times and never allow any member of the public to enter. This would simplify the procedural hazard controls that the FAA would require for protecting the public. However, based on experience at the federal launch ranges, a launch operator would likely need or desire to allow public access to the launch location. The proposed rule would allow public access to the launch location provided that the launch operator's systems incorporate specific safety designs and that specific procedural controls are implemented to ensure the safety of any visiting members of the public.

IV. Part Analysis

A. Part 413—License Application Procedures

Proposed part 413 continues to describe those license application procedures applicable to all license applications. The application procedures apply to license applications to launch a launch vehicle or to operate a launch site. More specific requirements applicable to obtaining a launch license or launch site operator license are set forth in parts 415 and 420. The FAA proposes to amend § 413.7 by adding a new paragraph (d) to require a license applicant to employ a consistent measurement system for each analysis, whether English or metric, in its application and licensing information. Errors stemming from failures to convert between English and metric units have resulted in mission failures of recent vintage. It is evident that such errors may have safety ramifications as well.

B. Part 415 Launch License

Part 415 will continue to contain requirements for obtaining a license to launch a launch vehicle. Proposed changes to part 415 would establish requirements for submitting an application to obtain a license to launch a launch vehicle from a non-federal launch site. Requirements applicable to obtaining a license to launch from a federal launch range will continue to be covered in subpart C of part 415. The application requirements specific to obtaining a license to launch from a non-federal launch site will be added to subpart F of part 415. Subpart F describes the material that a launch operator must submit to the FAA to demonstrate its ability to meet the part 417 safety responsibilities and requirements for launch. The provisions of part 415 as a whole apply to prospective and licensed launch operators and, where applicable, to prospective payload owners and operators, and should be read in conjunction with the general application requirements of part 413.

1. Part 415, Subpart D, Payload Review and Determination

The FAA proposes to amend § 415.51 to clarify that payloads otherwise exempted from an FAA payload review and determination are nonetheless still subject to review for purposes of launch safety. The particulars of this change are discussed earlier in this notice.

2. Part 415, Subpart E, Post—Licensing Requirements—Launch License Terms and Conditions

The FAA proposes to amend § 415.73(b)(2) to delete ''submitted in accordance with subpart D.'' The reference to subpart D appears to have been an error because subpart D only applies to a payload determination. In fact, the application amendment and license modification requirements apply regardless of whether the change is in subpart D or not.

3. Part 415, Subpart F, Safety Review and Approval for Launch From a non-Federal Launch Site

Proposed changes to subpart F of part 415 would apply to the safety review that the FAA requires as part of the licensing process for launch from a non-federal launch site. Section 415.101 would establish the scope of subpart F, which contains requirements for the application material that an applicant would submit to the FAA to demonstrate that it will meet the safety responsibilities and requirements for launch. Subpart F would also include all administrative requirements for submitting a license application, such as when data would have to be submitted and the form and content of each data submission. Material submitted to the FAA as required by proposed subpart F would measure an applicant's ability to comply with the launch operator responsibilities and technical requirements in proposed part 417. The related requirements in part 417 are referenced in this subpart where applicable. To facilitate the generation of the safety review material required by this subpart, an applicant would have to first become familiar with the launch operator requirements in part 417. The requirements in proposed subpart F apply to orbital launch vehicles and guided and unguided suborbital vehicles. Requirements in proposed § 415.103 through 415.125 apply to all proposed launches. The flight safety system related requirements in proposed §§ 415.127 through 415.131 apply to orbital launch vehicles and guided suborbital launch vehicles that use a flight safety system to ensure public safety

Section 415.103 would provide general FAA criteria for approval of an application to launch from a non-federal launch site. The FAA would conduct a safety review to determine whether an applicant is capable of launching a launch vehicle and its payload without jeopardizing public health and safety and safety of property. The FAA would issue a safety approval if an applicant satisfies the application requirements of subpart F and demonstrates, through the application process, that it will meet the safety responsibilities and requirements for launch from a non-federal launch site provided in part 417. The FAA will advise an applicant, in writing, of any issue raised during a safety review that would impede issuance of a safety approval. An applicant would have the option of responding in writing, or revising its license application.

Section 415.105 would require that an applicant conduct at least one pre-application consultation meeting with the FAA when planning to apply for a new launch license. This meeting would take place no later than 24 months before an applicant brings any launch vehicle to the proposed launch site and prior to an applicant's preparation of the flight safety analysis for its application. A launch operator must have a license before it brings a launch vehicle to the launch site and the application flight safety analysis is the earliest demonstration of an applicant's ability to protect public safety during launch. Section 415.105 would also provide requirements for the data to be presented during a pre-application consultation. This meeting would allow the FAA to review a proposed launch and provide a potential applicant with direction with respect to the licensing process and the required safety demonstrations. The FAA's proposed regulations for launch are meant to cover a broad range of launch vehicles and mission profiles. A pre-application consultation is considered necessary to focus an applicant on the applicable requirements and to ensure that the licensing process proceeds as efficiently as possible.

Section 415.107 would require that an applicant prepare a safety review document that contains all the information required by the FAA to conduct a safety review of a proposed launch and would address all aspects of an applicant's proposed launch safety program. This section would provide specific requirements for the form and content of an applicant's safety review document and reference appendix A to part 415, which would provide an outline for the document. Specific requirements for the content of each section identified in the outline would be provided in the remaining sections of subpart F. An applicant would identify any item incomplete at the time of a submission and provide a plan and schedule for completing the item. Any incomplete item would have to be finalized before conduct of the related operation. Once licensed, a licensee would be required to conduct its launch in accordance with an approved safety review document. A safety review document with the proposed standardized form and content would allow for efficiencies in the FAA's licensing review and approval process The FAA has 180 days to make a license determination upon receipt of a sufficiently complete application and the latest that a launch operator must have a license in place is when the launch vehicle arrives at the launch site. In order to facilitate these existing requirements, the FAA is proposing that the launch operator would have to submit a sufficiently complete safety review document no later than six months before the applicant brings any launch vehicle to the proposed launch site. The final safety review document would be used by a licensee and the FAA for ensuring the implementation of a launch safety program that protects public safety in accordance with part 417 and any special terms of a license.

Proposed § 415.109 would identify data describing a proposed launch that would be submitted to the FAA as part of an applicant's safety review document. The intent of this data is to provide the FAA with a general understanding of an applicant's proposed launch as needed to begin a safety review. This data would also allow for further focusing of the safety review process to the type of launch operations and hazards involved. An applicant would be required to identify each launch vehicle, each payload, and any payload customer. An applicant would be required to provide a launch schedule, launch site description, launch vehicle description, payload description, planned launch vehicle trajectory, description and time after liftoff of each launch vehicle staging event, and data describing the proposed launch vehicle's performance characteristics.

Proposed § 415.111 would ensure that a launch operator applicant's administrative information is submitted prior to or as part of a safety review application. Because an applicant may request a safety review independently of the other required licensing reviews, proposed § 415.111 would reference the specific launch operator administrative information identified in § 413.7 under the general license application procedures. If this information was previously submitted, an applicant's safety review document could reference the previously submitted documentation. Section 415.111 would also identify the launch operator organization data that an applicant would submit to verify compliance with the safety responsibilities and requirements of part 417. This data would include organizational charts, position descriptions, and information on an applicant's program for qualification, training, and certification of personnel who perform critical safety functions.

Proposed § 415.113 would require an applicant to submit information on how it will satisfy the personnel certification program requirements of proposed § 417.105. The FAA proposes that an applicant provide a summary description of its personnel certification program and other information that the FAA will use to evaluate the applicant's program. An applicant would be required to identify, by position, those individuals who implement the program and submit a copy of any program documentation used to implement the program and a table listing each safety critical task that would be performed by certified personnel. For each task, the table would be required to identify by position the individual who reviews personnel qualifications and certifies personnel for performing the task.

Proposed § 415.115 would require an applicant to submit information related to an applicant's program for protecting the public from hazards associated with the flight of a launch vehicle. Section 415.115(a) would require the submission of flight safety analysis data that demonstrated an applicant's ability to conduct a proposed launch in accordance with the public safety criteria required by part 417. This data would include information such as average number of expected casualties, individual risk, and ship and aircraft impact probabilities. This analysis data would also demonstrate an applicant's ability to operate a launch vehicle that uses a flight safety system to protect public safety or to operate an unguided suborbital rocket that uses a wind weighting safety system that protects the public. Requirements for performing a flight safety analysis would be provided in proposed part 417, subpart C. Section 415.115(a) would require that the flight safety analysis data submitted at the time of application be complete as specified in part 417 while allowing for situations where an analysis might need to be updated as a proposed launch date approaches. An applicant is not

required to finalize a flight safety analysis before the FAA would issue a license. An applicant would be required to perform the analysis with the best input data that is available at the time of application. An applicant would identify any analysis product that may change, describe what needs to be done to finalize the product and identify when before flight it will be finalized. An applicant would be required to submit its flight safety analysis data no later than 18 months before the applicant brings any launch vehicle to the proposed launch site. The flight safety analysis data for a new license may be extensive, depending upon the launch characteristics.

Significant FAA resources will be required to review the analysis data and ensure that the safety requirements of part 417 will be met for the proposed launch or series of launches. Similar coordination between a launch operator and the range safety organization for launch from a federal range typically begins two years or more before launch. For licensed launches, a launch operator must have a license before it brings any launch vehicle to the launch site. The FAA proposes that the 18-month requirement for the application flight safety analysis, coupled with the pre-application consultation required 24-months before the applicant brings any launch vehicle to the proposed launch site as proposed in § 415.105, provides an acceptable time frame for the necessary review and coordination before the launch operator would need a license, provided that all the analysis data is complete and submitted on time. The FAA will coordinate with an applicant on its flight safety analysis much earlier than required by the licensing process if an applicant so desires to provide greater assurance that the safety review can be completed in time for a planned launch date. An applicant's safety review document must describe each analysis method employed to meet the analysis requirements of part 417, subpart C, and contain the analysis products for each of the analyses. Once licensed, a launch operator would be required to perform flight safety analysis for each launch and submit launch specific analysis products using the analysis methods approved by the FAA during the licensing process or as a license modification. The proposed regulations would allow for a launch operator to perform an alternate flight safety analysis. The FAA would approve an alternate analysis if an applicant provides a clear and convincing demonstration that its proposed analysis provides an equivalent level of safety to that required by part 417, subpart C. A launch operator would be required to obtain FAA approval of an alternate analysis before its license application would be found sufficiently complete under § 413.11 to commence review.

Section 415.115(b) would require an applicant's safety review document to contain conjunction on launch assessment input data for the first proposed launch. The input data submitted as part of a license application would be required to satisfy the requirements of proposed § 417.233. The FAA will evaluate the launch operator's ability to prepare the input data and initiate coordination with United States Space Command. An applicant need not obtain a conjunction on launch assessment from United States Space Command prior to being issued a license.

Section 415.115(c) would require an applicant, for each proposed launch, to identify the type and quantity of any radionuclide on a launch vehicle or payload. The FAA proposes that for each radionuclide, an applicant provide the FAA with a reference list of all documentation that addresses the safety of its intended use and indicates approval by the Nuclear Regulatory Commission for launch processing. An applicant would provide radionuclide information to the FAA at the pre-application consultation. The FAA proposes to evaluate the flight of any radionuclide on a case-by-case basis. For such an evaluation the FAA's analysis will likely be informed by and reflect the National Aeronautics and Space Council, ''Nuclear Safety Review and Approval Procedure for Minor Radioactive Sources in Space Operations'' and the Presidential Decision Directive, National Security Council (PDD/NSC) 25, ''Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems into Space.

Section 415.115(d) would contain requirements for an applicant to submit a flight safety plan that specifies the flight safety rules, limits, and criteria identified by an applicant's flight safety analysis and the specific flight safety requirements of part 417 to be implemented for launch. An applicant's flight safety plan need not be restricted to public safety related issues and may address other flight safety issues as well so as to be all-inclusive. An applicant's flight safety plan would identify flight safety personnel and flight safety rules for each launch including flight commit criteria and flight termination rules. The plan would contain a summary description of any flight safety system and its operation including any preflight system tests to be performed. The flight safety plan would contain a summary of the launch trajectory and identify the flight hazard areas and safety clear zones established for each launch and procedures for surveillance and clearance of these areas. The flight safety plan would identify any support systems and services implemented as part of ensuring flight safety, including any aircraft and ships and procedures for their use during flight. A flight safety plan would contain a summary of the flight safety related tests, reviews, rehearsals, and other critical safety activities conducted according to proposed §§ 417.115 through 417.121. A flight safety plan would contain or reference procedures for accomplishing all flight safety activities. For an unguided suborbital rocket, a flight safety plan would contain the additional information required by proposed section 417.125.

Section 415.115(e) would require that if any of the natural and triggered lightning flight commit criteria in appendix G of part 417 do not apply to a proposed launch, an applicant's safety review document must contain a demonstration of the reason that each criterion does not apply. The criteria in appendix G cover a broad range of conditions, which apply to most launches from most launch sites; however, there may be exceptions.

Section 415.115(f) would require that, for the launch of an unguided suborbital rocket, the flight safety data submitted in an applicant's safety review document must meet the other requirements of proposed section 415.115 and demonstrate compliance with the requirements contained in proposed §§ 417.125 and 417.235. In addition to meeting the requirements in paragraph (d) of proposed § 415.115, an applicant's flight safety plan would be required to contain the launch angle limits, procedures for measurement of launch day winds and performing wind weighting, identification of flight safety personnel qualifications and roles for performing wind weighting, and the procedures for any recovery of a launch vehicle component or payload.

Proposed section 415.117 would require an applicant to submit a ground safety analysis report that would review each launch related system and operation and identify potential public hazards and the controls to be implemented to protect the public from each hazard. The report would describe all the launch operator's system and operations and show that all hazards that could affect the public have been

identified and controlled. A hazard that could affect the public is any hazard that extends beyond the boundaries of the launch location under the control of the individuals doing the work and that has the potential to effect the public regardless of where the public or property belonging to the public might be. An applicant would perform a ground safety analysis in accordance with the requirements in part 417, subpart E.

Section 415.117(a) would require a ground safety analysis report to be submitted as part of an applicant's safety review document and would contain requirements for the report's contents, timing requirements for submitting the report during the licensing process, requirements for informing the FAA of any changes, requirements for following the format prescribed by appendix C of proposed part 415, and verifiability and signature requirements.

Proposed section 415.117(b) would require an applicant to submit a ground safety plan that specifies the ground safety rules and procedures to be implemented to protect public safety. This plan would describe implementation of the hazard controls identified by an applicant's ground safety analysis and the specific ground safety requirements provided in subpart E of part 417. This plan need not be restricted to public safety related issues and may address other ground safety issues if an applicant intends it for all-inclusive uses. For example, if a launch operator intends to use the ground safety plan to address worker safety issues in response to OSHA requirements as well as the FAA's public safety requirements, the launch operator need not delete the material regarding worker safety. This is in keeping with the FAA's goal of not duplicating other agency requirements. The FAA does not wish, however, to drive launch operators into segregating what are otherwise intended as integrated safety plans.

Proposed § 415.119 would require a series of launch plans in addition to the flight and ground safety plans required by proposed §§ 415.115 and 415.117. Section 415.119(a) would require that each plan define how any associated launch operation is performed, identify operation personnel and their duties, contain mission specific information, and reference written procedures needed to ensure public safety. Each plan would identify personnel by position who implement the plan. Each plan must identify personnel by position who approve the baseline plan and any related procedures and any modification to the plan or procedures. The FAA would require that an applicant's safety review document include a copy of each launch plan to be implemented in accordance with part 417. The FAA will review these plans and procedures for compliance with part 417 and will reference these plans when performing inspections of a licensee's launch processing and flight operations.

Within each launch plan, an applicant shall provide any associated launch safety rules that satisfy proposed § 417.113. These written rules will govern operations conducted during launch processing and flight by identifying the environmental conditions and status of the launch vehicle, launch support equipment, and personnel under which operations may be conducted or allowed to continue without adversely affecting public safety. An applicant's launch safety rules would include, but need not be limited to flight commit criteria, weather constraints, flight termination rules, and launch crew rest rules. In addition to rules governing the flight of a launch vehicle, an applicant must provide rules that govern each preflight ground operation that has the potential to adversely effect public safety. In addition to complying with the generally applicable launch safety rules specified in proposed § 417.113, an applicant must develop launch safety rules specific to its planned launch based on the flight and ground safety analyses required by part 417.

Proposed § 415.119(b) through (n) would require launch plans in addition to the required flight and ground safety plans. These would include an emergency response plan, an accident investigation plan, a launch support equipment and instrumentation plan, a configuration management and control plan, a communications plan, a frequency management plan, a security and hazard area surveillance plan, a public coordination plan, any local agreements and plans, test plans, countdown plan, launch abort or delay recovery and recycle plan, a license modification plan, and a flight termination system electronic piece parts program plan. An applicant would be required to submit any plans and agreements with any local authority at or near a launch site whose support is needed to ensure public safety during launch processing and flight. Agreements with local authorities such as any site operator, U.S Coast Guard, and local air traffic control would have to be in place for the FAA to issue a license. Requirements for the implementation of these agreements are contained in part 417 and part 420. An applicant would also be required to submit an accident investigation plan that meets the requirements in part 415, subpart C, § 415.41. The accident investigation requirements for launch from a federal launch range in part 415, subpart C are also applicable to launch from a non-federal launch site. The FAA's approach to developing regulatory requirements is for the requirements to be performance oriented wherever possible, thereby allowing for any innovation that a launch operator may develop for their operations provided it accomplishes the related performance requirement. A launch operator's launch plans would document the launch operator's approach for compliance with the requirements. Each plan would become part of the terms of a license and the FAA would inspect a licensee for compliance with the license's launch plans.

Section 415.121 would require that an applicant submit a schedule for the tests, reviews, rehearsals, and safety critical launch operations conducted according to part 417. The schedule must show start and stop times for each activity referenced to time of liftoff for the first planned launch. An applicant would also be required to provide a written summary and point-of-contact for each scheduled activity. The FAA will review these schedules to verify an applicant's plans for complying with part 417. This data also will allow the FAA to focus on activities that are critical to public safety for each specific launch and efficiently schedule license compliance inspections.

Section 415.123 would contain requirements for the material that an applicant would be required to submit describing computing systems and software that perform a software safety critical function to be implemented in accordance with proposed § 417.123 and proposed appendix H of part 417. Reliance on computing systems and software as important components in flight safety systems and other safety critical systems and operations is expected to increase. The proposed requirements for safety critical computing systems and software were adapted from federal range requirements. The applicant would be required to demonstrate an effective program for ensuring the reliability of computing system and software that must operate properly to provide for public safety.

Section 415.125 would require an applicant to identify any public safety related policy and practice that is unique to the proposed launch

according to proposed § 417.127. The FAA would require an applicant to submit a written discussion on how each unique safety policy or practice provided for public safety.

Section 415.127 would identify the data that an applicant would be required to submit to describe any flight safety system employed during a proposed launch. The FAA proposes to define a flight safety system as the system that provides a means of control during flight for preventing a launch vehicle and any component, including any payload, from reaching any populated or other protected area in the event of a launch vehicle failure. Under the FAA's proposed definition, a flight safety system would include hardware and software used to protect the public and the functions of any personnel who operated flight safety system hardware and software. The proposed requirements for the applicability, design, qualification, and implementation of a flight safety system provided in part 417 and its appendices are a critical part of ensuring public safety. Ensuring that an applicant will implement a highly reliable flight safety system in accordance with part 417 would be one of the major objectives of the FAA's safety review of the proposed launch. Accordingly, the FAA proposes to require that data related to an applicant's flight safety system be thorough and be submitted no later than 18 months before the applicant brings any launch vehicle to the proposed launch site. An applicant also would be required to participate with the FAA in technical meetings to facilitate the review and approval of a flight safety system. An applicant's flight safety system data would be submitted in the same time frame as an applicant's flight safety analysis, thus allowing for efficient coordination of flight safety analysis and flight safety system issues.

The intent of proposed § 415.127 is to identify the descriptions, diagrams, schematics, tables, and charts needed by the FAA to verify compliance with the flight safety system requirements of part 417. Proposed part 417 and its appendices contain a significant number of specific system and component requirements. An applicant would be required to comply with each requirement that is applicable to its flight safety system or an applicant would be permitted to show that its system meets the intent of an applicable requirement. The applicability of each flight safety system requirement would be established through the FAA's review and approval of an applicant's flight safety system compliance matrix. This matrix would identify each requirement in part 417 and its appendices and indicate whether or not the requirement applied to an applicant's flight safety system. For each applicable requirement the matrix would indicate strict compliance or that the applicant's system would meet the intent of the requirement through other means, which would have to be further demonstrated and documented. Once approved as part of a launch license, this matrix and any supporting documentation would dictate the design and configuration of a licensee's flight safety system. Any change to a licensee's flight safety system would have to be submitted to the FAA for approval as a license modification.

Proposed § 415.129 would identify the test data that an applicant must submit regarding any flight safety system used for a proposed launch. Part 417 and its appendices would contain flight safety system test requirements intended to ensure that an applicant implements a highly reliable flight safety system. Ensuring the implementation of a flight safety system test program in accordance with part 417 will be another major objective of the FAA safety review. Part 417 would require the preparation of test plans, reports, and procedures. Section 415.129 would require that an applicant submit these documents and a test compliance matrix. This matrix would identify each test requirement in part 417 and its appendices and indicate whether or not the requirement applies to an applicant's flight safety system test program. For each applicable requirement the matrix would be required to indicate compliance or that the applicant's test program would meet the intent of the requirement through other means, which must be further demonstrated and documented. Once approved as part of a launch license, this matrix, and any supporting documentation, would dictate the flight safety system testing that must be implemented by a licensee. Any change to a licensee's test program would have to be submitted to the FAA for approval as a license modification. The proposed regulations would require that the test data be submitted to the FAA no later than 15 months before the applicant brings any launch vehicle to the proposed launch site; however, all flight safety system testing need not be completed before the FAA would issue a launch license. A licensee would be required to successfully complete all testing and submit completed test reports prior to flight.

Proposed § 415.131 would require an applicant to identify each flight safety system crew position and role that it planned to employ during the conduct of a launch. The FAA would require an applicant to identify the senior flight safety official by name and submit documentation on this individual's qualifications for the position showing compliance with the requirements in proposed § 417.343. The FAA would require an applicant to describe the certification and training program for the flight safety system crew.

4. Part 415, Appendix B, Safety Review Document Outline

Proposed appendix B of part 415 would contain the format and numbering scheme for a safety review document to be submitted as part of an application for a launch license. Administrative requirements applicable to a safety review document are provided in proposed § 415.107. Requirements for the form and content of each part of a safety review document are provided in parts 413 and 415. Technical requirements related to the information contained in a safety review document are provided in part 417. The applicable sections of parts 413, 415, and 417 would be referenced in the outline provided in proposed appendix A. A safety review document with the proposed standardized format and numbering scheme would allow for efficiencies in the FAA's licensing review and approval process.

5. Part 415, Appendix C, Ground Safety Analysis Report

Proposed appendix C of part 415 would provide the format and content requirements for a ground safety analysis report. Proposed section C415.1 would require an applicant to perform a ground safety analysis in accordance with subpart E of part 417 and submit a ground safety analysis report in accordance with proposed appendix C of part 415. A ground safety analysis report would contain hazard analyses that describe all hazard controls, and describe a launch operator's hardware, software, and operations so that the FAA may assess the adequacy of the hazard analysis. A launch operator would document all hazard analyses on hazard analysis forms according to proposed section C415.3(d) and submit systems and operations descriptions as a separate volume of the report. A ground safety analysis report would include a table of contents and provide definitions of any acronyms and unique terms used in the report. A launch operator's ground safety analysis report may reference other documents submitted to the FAA that contain the information required by this appendix

wherever applicable without repeating the data.

Proposed section C415.3 would describe the chapters that make up a ground safety analysis report. A ground safety analysis report must include an introductory chapter, a chapter that provides a summary of safety information about the launch vehicle and operations, including the payload and any flight safety system, and a chapter that provides safety information about each launch vehicle system, operation, and any associated interfaces. A ground safety analysis report must include a chapter containing a hazard analysis that identifies each hazard and all hazard controls to be implemented. A ground safety analysis report must also include a chapter containing data that supports the hazard analysis. Supporting data may include documents such as memoranda that explain why no public hazard exists for a particular hazardous system operation, or supporting data may display tables that consolidate hazard analysis information.

Proposed section C415.3(c) would contain the format requirements for describing systems and operations. A launch operator would also describe two kinds of hazards related to its flight safety system that could adversely affect the public. A launch operator would address potential inadvertent activation of a flight safety system, which could result in harm to the public, and the hazards created by ground operations that could adversely affect the reliability of the flight safety system itself. Any hazard controls implemented would be identified as part of the hazard analysis. For hazardous materials, a launch operator would identify any hazardous materials used in its flight and ground systems including the quantity and location of each. A launch operator would provide a summary of its approach to protecting the public from toxic plumes, including the toxic concentration thresholds used for controlling any public exposure and a description of any local agreements. Section C415.3(c) would also contain requirements for describing the subsystems of each hazardous system identified by the analysis. Proposed section C415.3(d) would contain an example hazard analysis form and an explanation of how to fill out the form. In addition to providing a launch operator further clarification on the data submitted as part of a ground safety analysis report, the use of this standard form would help facilitate the FAA's safety review process, allowing for greater efficiency in evaluating an applicant's ground safety analysis.

C. Part 417—Launch Safety, Subpart A, General

Proposed part 417, subpart A contains general requirements applicable to launch safety. Requirements for preparing a license application to conduct a launch, including related policy and safety reviews, are contained in parts 413 and 415. Because the provisions of part 417 would apply to prospective and licensed launch operators, an applicant seeking a license should read part 417 in conjunction with the application requirements of part 415, subpart F, and the general application requirements of part 413. Review of subpart F of part 415 will show that the subpart refers an applicant to the requirements proposed in part 417 on numerous occasions for purposes of the applicant demonstrating its ability to satisfy the requirements of part 417. Section 417.1 describes the scope of the requirements in part 417. Part 417 would prescribe the responsibilities of a launch operator conducting a licensed launch of an expandable launch vehicle and the requirements that a licensed launch operator must comply with to maintain a license and launch an expendable launch vehicle.

Section 417.3 contains definitions of terms used in proposed part 417.

Proposed § 417.5 would require that a launch operator ensure the safe conduct of a licensed launch. This section proposes that a launch operator ensure that members of the public and property belonging to the public are protected at all times during the conduct of a licensed launch, including preflight operations at a launch site and the flight of a launch vehicle.

Proposed § 417.7 would require a launch operator to ensure the safe conduct of launch processing at a launch site in the United States. A launch operator should anticipate that launch processing at a launch site outside the United States might be subject to the requirements of the governing jurisdiction. Requirements that apply to a launch site operator are contained in part 420. A launch operator would coordinate and perform launch processing in accordance with any agreements necessary to ensure that the responsibilities and requirements of this part and part 420 are met. Where there is a licensed launch site operator, a launch operator licensee would ensure that its operations are conducted according to any agreements that the launch site operator has with any local authorities. For example, under part 420, a launch site operator must obtain agreements with the FAA's regional office for air traffic services, and, if appropriate, the U.S. Coast Guard, *see* 14 CFR 420.57, to ensure that notices to airmen and mariners are issued before a launch. The launch operator must follow the procedures established by those agreements. A licensed launch operator would coordinate with the launch site operator and provide any information on its activities and potential hazards necessary to determine how to protect any other launch operators and persons and their property at the launch site. For a launch that is conducted from an exclusive use site where there is no launch site operator, the launch operator licensee would be responsible for meeting the requirements of this part and the public safety requirements of part 420, such as coordinating with the U.S. Coast Guard and the FAA's regional office for air traffic services.

Proposed § 417.9 would require a launch operator to conduct each launch in accordance with the safety review document developed during the part 415 licensing process, and maintained and updated for each specific launch in accordance with the requirements of proposed part 417. The FAA proposes that any launch specific update to a launch operator's safety review document be submitted to the FAA before flight. A launch operator would be required to submit the launch specific updates required by this part and any required by any special terms of a license as identified during the license application and evaluation process. Any other change to the information in a licensee's safety review document would have to be submitted to the FAA as a request for a license modification before flight in accordance with § 415.73 and the license modification plan required by proposed § 415.119.

Proposed § 417.11 would require a launch operator, for each specific launch, to verify that all license related information submitted to the FAA reflected the current status of the licensee's systems and processes as implemented for the specific launch. For each launch, a launch operator would submit a signed written statement to the FAA that the launch would be conducted in accordance with the terms and condition of the launch license and FAA regulations. The launch operator would also state in writing that all required license related information was submitted to the FAA and that the information reflected the current status of the licensee's systems and processes as implemented for that launch. The launch operator would be required to submit this written

statement to the FAA no later than ten days before the first planned flight attempt for each launch. The FAA evaluates each planned launch for compliance with the terms and conditions of the launch license and the regulations. The FAA would notify a launch operator of any licensing issue and coordinate with the launch operator to resolve any issue prior to flight. The proposed regulations would prohibit a launch operator from proceeding with the flight of a launch vehicle if there were any unresolved licensing issues.

Proposed § 417.11(e) would require a launch operator, for each licensed launch, to provide FAA with a console for monitoring the progress of the countdown and communication on all channels of the countdown communications network. The launch operator would be required to ensure that the FAA was polled over the communications network during the countdown to verify that the FAA had identified no issues related to the launch operator's license. Although the FAA will not be participating in the launch in an operational capacity, the FAA is proposing this requirement in order to ensure that if the FAA identifies any issues that all persons involved in the launch are aware of those requiring resolution prior to flight. The FAA's participation in the poll is not intended to provide any additional authorization to the launch operator, but merely to serve as a final opportunity to communicate any issues identified. The FAA's provision of a ''go'' or ready statement during a poll would not mean that issues could not be identified later. It would mean only that none had been identified at that time.

D. Part 417, Subpart B, Launch Safety Requirements

Proposed part 417, subpart B would contain launch safety requirements that apply to the launch of orbital and sub-orbital expendable launch vehicles. Section 417.101 would identify the scope of subpart B, which would provide an overview of the public safety issues that a launch operator's launch safety program would be required to address. For each public safety issue, subpart B would either provide the requirements in their entirety or would provide an overview of the requirements and reference other subparts, sections, or appendices that contain further detail.

Section 417.103 would contain requirements for a launch operator to maintain an organization that ensured public safety and ensured that the requirements of proposed part 417 were satisfied. This section would identify the management positions and organizational elements that a launch operator's organization would incorporate, and would require that each launch management position and organizational element have documented roles, duties, and authorities. These proposed requirements are based on the approach used at the federal launch ranges and reflect only the organization elements needed to implement the safety-related requirements in proposed part 417.

Proposed § 417.105 would require a launch operator to have a program for ensuring that its personnel have the necessary qualifications and certifications to perform safety critical tasks. Based on experience at the federal launch ranges, the use of qualified personnel who are certified to perform specific tasks is considered one of the most effective methods of ensuring the safety of launch operations. Section 417.105 would require a launch operator to identify and document the qualifications, including education, experience, and training, for each launch personnel position that oversees, performs, or supports a hazardous operation with the potential to impact public safety or who uses or maintains safety critical systems or equipment that protect the public. This section would also contain requirements for a launch operator's personnel certification/re-certification program to ensure that personnel possess the qualifications for their assigned tasks.

Proposed § 417.107 would contain general requirements for protecting the public from the hazards associated with the flight of a launch vehicle. Section 417.107(a) would contain requirements for employing a flight safety system that provides a means of control during flight for preventing a launch vehicle and any component, including any payload, from reaching any populated or other protected area in the event of a launch vehicle failure. Section 417.107(a) would also identify the conditions under which an unguided suborbital rocket may be flown with a wind weighting safety system and without a flight safety system and requirements for the potential use of an alternate flight safety system. Further discussion on the FAA's proposed flight safety system requirements, including the use of an alternate flight safety system is provided in paragraph III.F of this preamble.

Section 417.107(b) would contain the public risk criteria that each launch must satisfy. A launch operator would be required to demonstrate compliance with the public risk criteria through analysis and by establishing flight commit criteria that ensure that a launch will take place only if the public risk criteria are satisfied. A launch operator would be required to demonstrate that the risk level due to all hazards associated with the flight of a launch vehicle not exceed an expected average number of 0.00003 casualties per launch ($E_C \leq 30 \times 10^{-6}$), excluding water-borne vessels and aircraft. The FAA is proposing to codify the applicability of this criterion to all licensed launches, regardless of the launch site. A launch operator's determination of E_C for a launch shall account for, but need not be limited to, risk due to impacting debris and any risk determined for toxic release and distant focus overpressure blast. The risk to the public from launch of an expendable launch vehicle is typically due to three major hazards. Further discussion on the requirements for determining expected casualty is provided in paragraph III.E.8 of this preamble.

Compliance with the E_C criteria of 30×10^{-6} is a widely accepted approach for measuring and controlling the risk to the general public from launch activities and has been used successfully at the federal launch ranges. Experience at the federal launch ranges and a review of current and proposed commercial launch sites indicate there are possible situations where the E_C calculated for a specific launch could be at an acceptable level, but the risk to one or more individuals may be unacceptably high. Through this rulemaking the FAA proposes that in conjunction with demonstrating $E_C \leq 30 \times 10^{-6}$ for each launch, a launch operator also demonstrate that the casualty probability for any individual (P_C) does not exceed 0.000001 per launch ($P_C \leq 1 \times 10^{-6}$). This P_C criteria has been used successfully by some federal launch ranges and is based on statistical studies of the levels of involuntary risk that people are exposed to in every day life. The general logic being applied is that an individual member of the public, someone who is not involved with the launch of a launch vehicle, should not be exposed to any risk greater than the individual would otherwise be subjected to as part of a normal day. A launch operator would be required to establish an individual casualty contour according to proposed § 417.225 such that, if a single person were present inside that contour at the time of liftoff, the 1×10^{-6} criteria would be exceeded. The FAA would require an individual casualty contour to be treated as a safety clear zone and a launch operator would be required to ensure that no member of

the public is present within the safety clear zone during the flight of a launch vehicle.

The FAA proposes to use the criteria for ship and aircraft hit probability used at federal launch ranges for creating ship and aircraft hazard areas. A launch operator would be required to demonstrate that the risk probability of a launch vehicle or debris impacting any individual water-borne vessel that is not operated in direct support of the launch does not exceed 0.00001 ($P_I \leq 1 \times 10^{-5}$). The FAA proposes that the risk probability of a launch vehicle or debris impacting any individual aircraft not operated in direct support of the launch shall not exceed 0.00000001 ($P_I \leq 1 \times 10^{-8}$). A launch operator would be required to establish ship and aircraft impact hazard areas according to proposed § 417.225 to ensure these criteria are satisfied. Section 417.107(c) would require a launch operator to ensure that a launch vehicle, any jettisoned components, and its payload do not pass closer than 200 kilometers to a habitable orbital object throughout a sub-orbital launch. For an orbital launch, a launch operator would be required to ensure that a launch vehicle, any jettisoned components, and its payload do not pass closer than 200 kilometers to a habitable orbiting object during ascent to initial orbital insertion through at least one complete orbit. The FAA would require a launch operator to obtain a conjunction on launch assessment from United States Space Command according to proposed § 417.233 and to use the results to develop flight commit criteria that ensure the 200-kilometer criteria is satisfied. The flight commit criteria would typically identify specific periods of time (waits) during a launch window where flight must not be initiated. The FAA is in discussions with United States Space Command regarding a process for commercial launch operators to obtain a Conjunction On Launch Assessment (COLA). There may be other methods of obtaining this analysis; however, United States Space Command is the primary source of the most current data on orbital objects and must perform this analysis as part of its mission to protect national assets on orbit. The FAA proposes to require that a COLA be performed to protect habitable orbital objects such as the space shuttle and the international space station as is the current practice at the federal launch ranges. A launch operator may request COLA results for other orbital objects as desired for mission assurance purposes.

Section 417.107(d) would require a launch operator to perform and document a flight safety analysis according to subpart C of proposed part 417. The analysis must demonstrate compliance with the public risk criteria specified in paragraph (b) of proposed § 417.107 and establish flight safety limits for each launch. A launch operator would be required to use the analysis products to develop launch safety rules, including flight commit and flight termination criteria, to ensure that the public risk criteria are met. Further discussion on the proposed flight safety analysis requirements is provided in section III.E of this preamble.

Section 417.107(e) would require that the launch of any radionuclide be approved by the FAA as part of the launch licensing process according to proposed § 415.115 or a launch operator would be required to apply for a license modification. The launch of any radionuclide involves special safety considerations as well as possible coordination with other government agencies that may have jurisdiction. FAA safety review and approval of a launch involving any radionuclide would be handled on a case-by-case basis. For each launch, a launch operator would be required to verify that the type and quantity of any radionuclide on a launch vehicle or payload is in accordance with the terms of its launch license.

Section 417.107(f) would require a launch operator to implement a flight safety plan prepared as required during the license application process according to proposed § 415.115 and in accordance with the launch plan requirements in proposed § 417.111. Specific requirements applicable to a flight safety plan for the launch of an unguided suborbital launch vehicle are provided in proposed § 417.125.

Proposed § 417.109 would require a launch operator to perform a ground safety analysis and implement a ground safety plan to protect the public from adverse affects of operations associated with preparing a launch vehicle for flight at a launch site in the United States. Specific ground safety requirements that must be met by a launch operator would be provided in proposed subpart E of proposed part 417. Further discussion on the proposed ground safety requirements is provided in section III.G of this discussion.

Proposed § 417.111 would contain requirements for a launch operator to update, maintain, and implement its launch plans developed during the licensing process according to proposed § 415.117. The FAA's approach to developing regulatory requirements is for the requirements to be performance oriented wherever possible, thereby allowing for any innovation that a launch operator may develop for its operations, provided the innovation accomplishes the related performance requirement. A launch operator's launch plans would document the launch operator's approach for compliance with the performance requirements. Each plan would become part of the terms of the license and the FAA would inspect a licensee for compliance with the license's launch plans.

Proposed § 417.113 would contain requirements for written launch safety rules that govern launch. The launch safety rules would identify the environmental conditions and status of the launch vehicle, launch support equipment, and personnel under which launch operations may be conducted without adversely affecting public safety. Launch rules would address flight and ground safety issues and would be documented in a launch operator's launch plans. The flight and ground safety analyses that would be required by proposed subparts C and E of part 417 would be used to establish many of a launch operator's launch safety rules. Section 417.113 would also contain specific requirements for flight commit criteria, flight termination criteria, and launch crew work shift and rest rules.

Proposed § 417.115 would contain requirements for testing all flight and ground systems and equipment that protect the public from the adverse effects of a launch. A launch operator would be required to determine the cause of any discrepancy identified during testing, develop and implement any correction, and perform re-testing to verify each correction. A launch operator would be required to notify the FAA of any discrepancy identified during testing and submit information on corrections implemented and the results of re-testing before the system or equipment would be used in support of a launch. The configuration of safety critical systems may change from one flight to the next. Testing of safety critical systems in preparation for each launch in the configuration used for the launch is considered one of the most effective approaches for ensuring the reliability of the safety critical systems when needed during launch processing and flight.

Proposed § 417.117 would contain requirements for review meetings that a launch operator would be required conduct to determine the status of launch operations, systems, equipment, and personnel and their readiness to support launch and to review the results of a launch. This section would contain

the general requirements that apply to all reviews and would identify the specific reviews that a launch operator must conduct for each launch. A launch operator would maintain documented criteria for successful completion of each review and document all review proceedings. Any corrective actions identified during a review would be documented and tracked to completion. Launch operator personnel who oversee a review would attest in writing to successful completion of the review. The series of reviews that would be required reflect a proven practice for ensuring safety issues are identified and resolved prior to launch based on the experience of the federal launch ranges.

Proposed § 417.119 would contain requirements for rehearsals designed to exercise all launch personnel and systems under nominal and non-nominal preflight and flight conditions and identify corrective actions or operational changes needed to ensure public safety. This section would contain general requirements that apply to all rehearsals and would identify the specific rehearsals that a launch operator would conduct for each launch.

A launch operator would develop and conduct the rehearsals identified in proposed § 417.119 for each launch unless otherwise approved by the FAA through the licensing process. For example, when conducting a series of launches within days of one another, a launch operator may propose that one rehearsal applies to more than one launch. The FAA would consider such a proposal if all the same personnel are involved in each launch and the launch operator demonstrates that an equivalent level of safety is achieved.

Proposed § 417.121 would contain requirements for the safety critical preflight operations that a launch operator would perform to ensure public safety. A safety critical preflight operation is an activity performed specifically to protect the public from any adverse effects of a launch vehicle's flight or from hazards associated with launch processing at a launch site, including activities such as disseminating notices of hazard areas and surveillance of hazard areas to ensure that flight commit criteria are satisfied. This section would contain general requirements that apply to all safety critical preflight operations and would contain requirements for specific safety critical preflight operations that a launch operator would conduct for each launch.

Proposed § 417.123 would require a launch operator to ensure that any flight and ground computing system that performs or potentially performs a software safety critical function is implemented in accordance with the requirements of appendix H of proposed part 417. A launch operator would identify any software safety critical functions, as defined by appendix H, associated with handling, pre-flight assembly, checkout, test, or flight of a launch vehicle including any computing systems and software that are part of a flight safety system. The proposed software safety approach is an adaptation of the approach that has been successfully implemented at the Air Force launch ranges and is one with which most current launch operators are familiar.

Proposed § 417.125 would contain requirements that apply specifically to the launch of an unguided suborbital rocket. The process of ensuring public safety for such a launch is typically completed prior to flight and involves setting the launcher azimuth and elevation (aiming the rocket) to correct for the effects of actual time of flight wind conditions to provide a safe impact location. This safety process, called wind weighting, has some unique organizational and operational requirements. Unlike the launch of a guided launch vehicle, an unguided suborbital rocket may be flown without a flight safety system that provides safety control during flight. This section would contain the specific requirements under which an unguided suborbital rocket may be flown with a wind weighting safety system and without a flight safety system.

Proposed § 417.127 would contain requirements for a launch operator to review operations, system designs, analysis, and testing, and identify and implement any additional policies and practices needed to protect the public. The FAA suggests that this include public safety related practices designed to ensure that there are no conflicts with the requirements of other Federal, State, and local regulations and to ensure that any necessary agreements and interfaces are in place. A launch operator is responsible for all aspects of public safety. As the launch industry continues to grow, advances in technology and implementation of innovations by launch operators will likely introduce new and unforeseen public safety issues. The FAA plans to work with launch operators on a case-by-case basis to resolve any public safety issues not specifically addressed by current regulations. A launch operator would be required to implement any unique safety policies and practices identified during the licensing process and documented in the launch operator's safety review document. For any new launch operator unique safety policy or practice or change to an existing safety policy or practice, the launch operator would be required to submit a request for license modification.

E. Part 417, Subpart C, Flight Safety Analysis

Proposed subpart C would contain the requirements governing a launch operator's performance of flight safety analysis to demonstrate a launch operator's capability to monitor and control risk to the public from normal and malfunctioning launches. Proposed section 417.201 would identify the scope of subpart C. A flight safety analysis consists of a number of analyses, which in some cases are dependent on one another. The sections of subpart C would contain performance standards for each of the analyses that make up an overall flight safety analysis. This subpart would also identify the analysis products that a launch operator would submit to the FAA when applying for a launch license and that would be submitted for each specific launch. Further discussion on the proposed flight safety analysis requirements is provided in section III.E of this preamble.

Proposed § 417.203 contains general requirements that apply to performing flight safety analysis, incorporating the analysis products into the launch operator's flight safety plan, and submitting analysis products to the FAA. The FAA anticipates that different launch operators will employ different methods for satisfying the requirements of proposed subpart C. In the course of the licensing process the FAA will review a launch operator's proposed method and determine whether it satisfies the FAA's requirements. Accordingly, a launch operator may not change its methods for conducting a flight safety analysis without FAA approval, and a launch operator would be required to submit any change to a launch operator's flight safety analysis methods to the FAA as a request for license modification before the launch for which it was performed.

Section 417.203 would require that a launch operator meet the requirements of proposed subpart C unless the FAA approves an alternate analysis during the license application process or as a license modification. The FAA would approve an alternate analysis if a launch operator provided a clear and convincing demonstration that its proposed analysis provided an equivalent level of safety to that required by proposed subpart C. A launch operator would have to obtain

FAA approval of an alternate flight safety analysis before its license application or application for license modification could be found sufficiently complete.

Proposed § 417.205 contains requirements governing a trajectory analysis that a launch operator would perform to define the limits of a launch vehicle's normal flight for any time after liftoff. Many of the other analyses, such those performed to establish flight safety limits and hazard areas, would use the products of the trajectory analysis as input.

Proposed § 417.207 contains requirements governing a malfunction turn analysis that a launch operator would perform to determine a launch vehicle's greatest turning capability as a function of trajectory time. A launch operator would use the products of its malfunction turn analysis as input to its flight safety limits analysis and other analyses where it is necessary to determine how far a launch vehicle's impact point can deviate from the nominal impact point ground trace if a malfunction occurs.

Proposed § 417.209 contains the requirements governing a debris analysis that a launch operator would perform to determine the inert, explosive, and otherwise hazardous launch vehicle debris resulting from a launch vehicle malfunction and from any planned impact of a jettisoned launch vehicle stage, component, or payload. A launch operator would develop debris models in the form of lists of the debris that is planned as part of a launch or that results from breakup of the launch vehicle. Each list would describe each debris piece produced, its physical characteristics, whether it is inert, explosive or otherwise hazardous, and the effects of impact, such as explosive overpressure, skip, splatter, or bounce radius, including its effective casualty area.

A launch operator would use the products of its debris analysis as input to other flight safety analyses such as those performed to establish flight safety limits and hazard areas and to determine if the launch satisfies the public risk criteria.

Proposed § 417.211 contains requirements governing the analysis that a launch operator would perform to determine the geographic placement of flight control lines that define the region over which a launch vehicle will be allowed to fly and any debris resulting from normal flight and any launch vehicle malfunction, will be allowed to impact. As part of a flight control lines analysis, a launch operator would identify the boundaries of populated and other areas requiring protection from potential adverse effects of a launch vehicle's flight. A launch operator would ensure that the flight control lines bound all such protected areas. A launch operator would use the flight control lines to establish flight termination rules used in conjunction with a flight safety system to ensure that the debris associated with a malfunctioning launch vehicle does not impact any populated or other protected area outside the flight control lines. Proposed § 417.213 would contain requirements governing a flight safety limits analysis that a launch operator would perform to establish criteria for terminating a malfunctioning launch vehicle's flight. These flight termination criteria used in conjunction with a flight safety system would ensure that the launch vehicle's three-sigma debris impact dispersion, including the effects of any explosive debris, did not extend beyond the flight control lines established according to proposed § 417.211. A launch operator's flight safety limits analysis would determine a set of temporal and geometric extents of a launch vehicle's debris impact dispersion on the Earth's surface resulting from any planned debris impacts and potential debris impacts resulting from launch vehicle failure. A launch operator's flight safety limits would provide for the identification of a launch vehicle malfunction with sufficient time to terminate flight to prevent the adverse effects of the resulting debris from reaching any protected area outside the flight control lines.

Proposed § 417.215 would contain requirements governing a straight-up time analysis that a launch operator would perform to determine the latest time-after-liftoff by which flight termination would be initiated in the event of a launch vehicle malfunction resulting in the launch vehicle flying a vertical or near vertical trajectory, referred to as a straight-up trajectory, rather than following a normal trajectory downrange. Straight-up time is a special type of flight safety limit used to address this specific type of failure. In the event of such a failure, the launch operator would terminate flight at the straight-up time to ensure that debris or critical over-pressure does not extend outside the flight control lines in the launch area.

Proposed § 417.217 contains requirements governing a wind analysis that a launch operator would perform to determine wind magnitude and direction as a function of altitude for the air space through which its launch vehicle will fly and for the airspace through which jettisoned debris will travel. The products of this analysis would have to satisfy the input requirements of the other flight safety analyses that are dependent on wind data. Additional wind analysis requirements for the launch of an unguided suborbital rocket using a wind weighting safety system would be contained in proposed § 417.235 and appendix C of part 417.

Proposed § 417.219 contains requirements governing a no-longer terminate gate analysis that a launch operator would perform to determine the portion, referred to as a gate, of a flight control line or other flight safety limit boundary, through which a launch vehicle's tracking icon is allowed to proceed without a launch operator being required to terminate flight. A tracking icon is the representation of a launch vehicle's position in flight available to a flight safety official during real-time tracking of the launch vehicle's flight. A launch operator would be permitted to employ a gate for planned launch vehicle flight over a populated or other protected area only if the launch could be accomplished while meeting the public risk criteria of proposed § 417.107.

Proposed § 417.221 contains requirements governing a data loss flight time analysis that a launch operator would perform to determine the shortest elapsed thrusting time during which a launch vehicle can move from a state where it does not endanger any populated or other protected area to a state where endangerment is possible. A data loss flight time analysis would also determine the earliest destruct time, which is the earliest time after liftoff that public endangerment is possible, and the no longer endanger time, which is the earliest time after liftoff that public endangerment is no longer possible. A launch operator would employ data loss flight times following any malfunction that prevents the flight safety official from knowing the location or behavior of a launch vehicle. A launch operator would be required to incorporate data loss flight times into the flight termination rules for each launch.

Proposed § 417.223 contains requirements governing a time delay analysis that a launch operator would perform to determine the mean elapsed time between the start of a launch vehicle malfunction and the final commanded flight termination, including the flight safety official's decision and reaction time. A launch operator would also determine the time delay plus and minus three-sigma values relative to the mean time delay.

A time delay analysis would account for data flow decelerations, decision time, and reaction time due to hardware, software, and personnel that comprise a launch operator's flight safety system and would be used to establish flights safety limits.

Proposed § 417.225 contains requirements governing a flight hazard area analysis that a launch operator would perform to determine the regions of land, sea, and air that must be publicized, monitored, controlled, or evacuated to protect the public from the adverse effects and hazards of planned and unplanned launch vehicle flight events and to ensure that the public risk criteria in proposed § 417.107(b) are satisfied. A launch operator's flight hazard area analysis would define the ship and aircraft hazard areas for which Notices to Mariners (NOTMAR) and Notices to Airman (NOTAM) must be issued and the areas where the launch operator would survey prior to flight. The products of a launch operator's flight hazard area analyses would be used to establish launch safety rules. Typically, these rules would preclude liftoff if the public would be exposed within a flight hazard area or if the extent of public presence would exceed the public risk criteria of proposed § 417.107(b).

Proposed § 417.227 contains requirements governing a debris risk analysis that a launch operator would perform to determine the expected average number of casualties (E_C) to the collective members of the public exposed to inert and explosive debris hazards from any one launch. This analysis would include an evaluation of risk to populations on land, including regions of launch vehicle flight following passage through any gate in a flight safety limit boundary established according to proposed § 417.219. The requirements in proposed § 417.227 apply to a debris risk analysis for all launches. A launch operator would perform a debris risk analysis using the methodology provided in appendix B of proposed part 417. This analysis would be part of the launch operator's demonstration of compliance with the overall (E_C) criteria of 30×10^{-6}.

Proposed § 417.229 contains requirements governing a toxic release analysis that a launch operator would perform to determine any potential public hazard resulting from any potential toxic release during preflight processing and flight of a launch vehicle and to develop launch safety rules, including flight commit criteria to protect the public from any potential toxic release. A launch operator would perform a toxic release analysis using the methodology contained in appendix I of proposed part 417.

Proposed § 417.231 contains requirements governing a distant focus overpressure blast effects analysis that a launch operator would perform to demonstrate that the potential public hazard resulting from impacting explosive debris would not cause windows to break with related injuries. In order to satisfy the requirements of this section, a launch operator would be required to evaluate potential distant focus overpressure blast effects hazards in accordance with a multi-level screening approach, in which the launch operator would employ either a deterministic analysis or a probabilistic analysis, to prevent casualties that could arise due to potential distant focus overpressure blast.

Proposed § 417.233 contains requirements governing the performance of a conjunction on launch assessment that a launch operator would obtain from United States Space Command. A launch operator would implement any waits in the launch window, as identified by United States Space Command, during which flight must not be initiated in order to maintain a 200-kilometer separation from any habitable orbiting object. A licensee may request a conjunction on launch assessment be performed for other orbital objects to meet mission needs or to accommodate other satellite owners or operators.

Proposed § 417.235 contains requirements governing flight safety analysis for the launch of an unguided suborbital rocket that is flown with a wind weighting safety system and without a flight safety system. A launch operator would demonstrate that any adverse effects resulting from flight would be contained within controlled operational areas and any flight hardware or payload impacts would occur within planned impact areas. The launch operator would also demonstrate compliance with the public risk criteria. A launch operator would perform the analyses using the methodologies contained in appendixes B and C of proposed part 417.

F. Part 417, Subpart D, Flight Safety System

Subpart D would contain requirements applicable to a launch operator's flight safety system, the primary purpose of which is to prevent a launch vehicle from impacting populated or other protected areas in the event of a launch vehicle failure.

Proposed § 417.301 contains general requirements applicable to any type of flight safety system including any that may differ from the human operated system traditionally used in the United States. A launch operator would ensure that a flight safety system satisfies all the requirements of subpart D unless the FAA approves the use of an alternate flight safety system in accordance with proposed § 417.107(a). The FAA will evaluate any alternate flight safety system on a case-by-case basis.

An example of a flight safety system for which all of the requirements in subpart D do not apply is the thrust termination system employed by Russian and Ukrainian launch vehicles. The FAA has licensed Sea Launch launches, which use such a thrust termination system. The Sea Launch licensing determination was made based on a clear understanding of how the thrust termination system compares with the requirements in proposed subpart D. With that and a review of all safety related issues and the specifics of each launch of Sea Launch, including the remote isolation of the launch site, the FAA determined that an acceptable level of public safety was being provided that was equivalent to a commercial launch from a United States federal launch range. (Further discussion on the issue of using an alternate flight safety system that does not meet all the requirements of subpart D of proposed part 417 is provided in section III.F.7 of this discussion.) The requirements in proposed subpart D are based on the use of a human operated system where flight termination is initiated by radio command. When evaluating an alternate flight safety system, the FAA will use the requirements in subpart D as guidelines, where applicable, for which the launch operator must demonstrate an equivalent level of safety.

A launch operator's flight safety system would consist of a flight termination system, a command control system, and the support systems defined in this subpart, including all associated hardware and software. A flight safety system would also include the functions of any personnel who operate flight safety system hardware and software. A launch operator would be required to satisfy each requirement in this subpart, including all requirements contained in referenced appendices, by meeting the requirement or by employing an alternate method approved by the FAA through the licensing process. The FAA will approve an alternate method if a launch operator provides a clear and convincing demonstration that its proposed method provides an equivalent level of safety to that required by subpart D. A launch operator would have to obtain FAA approval of any proposed alternate

method before its license application or application for license modification could be found sufficiently complete.

A launch operator would implement a test program for its flight safety system that demonstrates the ability of flight safety system components to meet the design margins and reliability requirements of proposed subpart D.

Any change to a licensee's flight safety system design or flight safety system test program that was not coordinated during the licensing process would be submitted to the FAA for approval as a license modification prior to flight. The modification requirement of § 415.73 is of special significance in the context of a flight safety system. Each requirement of proposed subpart D is designed to ensure that a launch takes place with a reliable and functioning flight safety system. A licensee must obtain FAA approval through the license modification process before implementing any changes. This includes any changes that may occur shortly before flight itself. The FAA's proposed license application timetable for submitting complete flight safety system design data and test program described in proposed §§ 415.127 and 417.129 respectively is intended to reduce the number of last minute changes and consequent delays.[16]

Prior to the flight of each launch vehicle, a licensee would confirm to the FAA in writing that its flight safety system is as described in its license application, including all applicable application amendments and license modifications, and complies with any terms of the license and the requirements of proposed part 417. Upon review of a proposed launch, the FAA may identify and impose additional requirements needed to address unique issues presented by a flight safety system, including its design, operational environments, and testing.

Proposed § 417.303 contains functional requirements for a flight termination system. A flight termination system is a major part of a flight safety system and consists of the hardware and software onboard a launch vehicle that accomplish the termination of flight in the event of a launch vehicle failure. Proposed § 417.303 would identify the functions that a flight termination system must accomplish to stop the flight of a launch vehicle and disperse hazardous energy in a way that protects public safety. Once initiated, a flight termination system would render each stage and any other propulsion system, including any propulsion system that is part of a payload, with the capability of reaching a populated or other protected area, non-propulsive and any stage or propulsion system not thrusting at the time the flight termination system is initiated would be rendered incapable of becoming propulsive. Rendering each stage and propulsion system non-propulsive would ensure that the impact location of the launch vehicle pieces could be accurately predicted and allows for the development of flight termination criteria that would prevent the launch vehicle, any component, or payload from impacting populated or other protected areas. A flight termination system would cause rapid dispersion of any liquid propellant by rupturing the propellant tank or other equivalent method and initiate burning of any toxic liquid propellant. The release of a toxic propellant like hydrazine could pose a significant risk to public safety. The proposed requirement would ensure that the concentrations of any liquid propellants are reduced to non-hazardous levels as quickly as possible and thereby minimize the risk of a toxic cloud reaching a populated or other protected area.

A flight termination system would include a command destruct system that is initiated by radio command. Use of a radio command destruct system is the proven method for ensuring public safety from a malfunctioning launch vehicle that has been used at United Stated launch ranges for over 40 years. The FAA will evaluate the use of any other type of system in place of a command destruct system, such as an autonomous flight termination system, on a case-by-case basis. In such a case, the launch operator would be required to provide a clear and convincing demonstration that its proposed method provided an equivalent level of safety.

A flight termination system would provide for flight termination of any inadvertently or prematurely separated stage or strap-on motor capable of reaching a populated or other protected area before orbital insertion. Some rocket stages, primarily strap-on solid rocket motors, may be capable of continued flight after becoming separated from the main launch vehicle if their propellant is not exhausted and continues to burn or begins to burn and produce thrust. Each stage or strap-on motor that does not possess its own complete command destruct system must be equipped with an inadvertent separation destruct system. An inadvertent separation destruct system would be considered a part of the overall flight termination system. The commonly employed inadvertent separation destruct system, frequently referred to as an ISDS, responds to a launch vehicle breaking up on its own and does not respond to guidance errors. An inadvertent separation destruct system is intended to ensure that the flight of any stage or booster that becomes separated from the main vehicle would be terminated.

Proposed section 417.305 contains requirements that a flight termination system must satisfy to ensure that it is capable of accomplishing the functional requirements contained in proposed section 417.303 with a high level of reliability. The FAA is proposing that a flight termination system have a reliability design of 0.999, which would be demonstrated through analysis. Historically, the federal launch ranges have mandated that a flight termination system have a design ''goal'' of 0.999 at a 95% confidence level. The FAA recognizes that flight termination systems are not tested several thousand times to prove the 95% confidence level because of the costs and the difficulty in trying to test the complete system. Instead, the federal launch ranges have relied on specific component test requirements with a strong heritage of success behind them to provide an acceptable level of confidence in the design and manufacture of a flight termination system's components. The federal launch ranges also rely on a series of system tests performed after flight termination system installation on the launch vehicle to ensure the integrity of the system as installed. Accordingly, the FAA's proposed reliability design requirement is directed at ascertaining whether a launch operator's flight termination system employs reliable components, and whether they are assembled to enhance reliability of the system. In order to achieve a reliability design of 0.999, a flight termination system's design is expected to incorporate high quality, highly reliable parts that are assembled using redundancy and other system reliability design approaches. A launch operator would prepare the system analyses required by proposed § 417.329 to demonstrate through analysis the reliability design of its

[16] Section 70107 of ch. 701 provides that a licensee may apply for a modification to its license. 49 U.S.C. § 70107. Section 70105 provides that a person may apply for a license or its transfer, and imposes a time limit of 180 days on the FAA on issuing or transferring a license. It does not impose a corresponding time limit on license modifications. It does not thus appear that the FAA is burdened by the same time constraints as a licensee facing an imminent launch if that licensee wishes to effectuate a change. However, the FAA will, as a matter of policy, treat 180 days as an internal goal by which to complete its review.

flight termination system. A launch operator would demonstrate confidence in a flight termination system by performing specific component and system testing adapted from the approach used at the federal ranges. Proposed § 417.303 also contains requirements for redundancy of flight termination system components and system independence and physical separation from other launch vehicle systems. Requirements for specific components, piece parts, and software would be contained in appendixes D, F, and H respectively.

Proposed § 417.307 contains requirements for ensuring that a flight termination system would function when subjected to flight and other environments. A flight termination system must function under conditions that would exist after other systems on the launch vehicle have failed. The design of a flight termination system and its components, including all mounting hardware, cables and wires, would provide for the system and each component to function without degradation in performance when subjected to dynamic environments greater than those it is expected to experience during environmental stress screening tests, ground transportation, storage, launch processing, system checkout, and flight up to the point that the launch vehicle could no longer impact any populated or other protected area or to the point that any combination of environments would cause structural breakup of the launch vehicle. For example, the most extreme thermal environment might occur while a vehicle is still in the atmosphere, but structural break up might produce the most extreme vibration environment.

Proposed § 417.307 would identify required design environments with which launch operators conducting launches at federal launch ranges are already familiar. The FAA proposes to adopt these federal launch range requirements because they represent proven environmental design safety factors intended to ensure that a system can withstand the environments to which it will be exposed without degradation in performance.

A launch operator would establish the maximum predicted environments for the operating and non-operating environments that a flight termination system is to experience based on analysis, modeling, testing, or flight data. Proposed § 417.307 would identify the specific environments that apply to the design of a flight termination system. The federal launch ranges historically have obtained information regarding each of the enumerated environmental factors because of the ability of those factors to affect the performance and reliability of a flight termination system and its components. For the same reasons, the FAA is proposing to codify these requirements as part of its proposed regulations.

A launch operator would verify its maximum predicted environments through monitoring and ensure that the maximum predicted environments for future launches are adjusted as needed based on the flight data obtained via monitoring. The FAA is also proposing the federal launch ranges' safety margins be added to maximum predicted environments obtained through analysis for launch vehicles that cannot yet provide at least three samples of flight data. A launch operator would ensure that transportation, storage, launch processing, and system checkout environments are monitored and the associated maximum predicted environments are adjusted as needed. A launch operator would be required to notify the FAA of any change to a maximum predicted environment because any change may indicate the need for a change in the design of a flight termination system or component.

Proposed § 417.309 contains requirements applicable to a command destruct system, which is a critical part of a flight termination system. A flight termination system would include at least one command destruct system that is initiated by radio command and meets the redundancy and other component requirements provided in proposed appendix D of proposed part 417. The initiation of a command destruct system by the flight safety official would result in accomplishing all flight termination functions required by proposed section 417.303. A command destruct system would process a valid arm command as a prerequisite for destroying the launch vehicle. For any liquid propellant, when the arm command is received, the command destruct system would nondestructively shut down any thrusting liquid engine as a prerequisite for destroying the launch vehicle. This capability provides a flight safety official with additional options in controlling the termination of a launch vehicle's flight. There are possible situations where it would be desirable to terminate the thrust of a malfunctioning launch vehicle but allow it to continue to fly a ballistic path for a period of time to move away from a populated or other protected area before destroying the launch vehicle. It is also possible to reduce the size of the debris footprint by terminating the thrust of a launch vehicle that is at a high altitude and allow it to fall to a lower altitude before destroying the launch vehicle.

Proposed § 417.311 contains requirements for an inadvertent separation destruct system (ISDS). Each stage or strap-on motor, capable of reaching a populated or other protected area, that does not possess its own complete command destruct system would be equipped with an inadvertent separation destruct system. An inadvertent separation destruct system may be required on a stage that has a command destruct system depending on the command destruct system's ability to survive breakup of the launch vehicle. Initiation of an inadvertent separation destruct system would result in accomplishing all flight termination system functions that apply to the stage or strap on motor on which it is installed in accordance with proposed § 417.303.

Proposed § 417.313 contains requirements governing the safing and arming of a flight termination system. Safing a flight termination system typically involves placing a mechanical barrier or other means of interrupting power between each of the ordnance firing circuits and its power source. Safing places the system's firing circuits in a state that prevents initiation of the system's ordnance. Arming a flight termination system removes any firing circuit barriers or other means of safing the system and places the firing circuits in a state from which the system's ordnance can be initiated if commanded. The ability to safe and arm a flight termination system prevents any inadvertent initiation of any flight termination system ordnance while allowing a flight termination system to function in case destruction of the launch vehicle is required. Although many of the immediately apparent benefits of safing a flight termination system accrue to the protection of workers, a safe and arm system also prevents inadvertent initiation of a flight termination system that could result in consequences propagating to the public. Safing and arming of flight termination system ordnance would be accomplished through the use of ordnance initiation devices or arming devices, also referred to as safe and arm devices, that provide a removable and replaceable mechanical barrier or other means of interrupting power to each of the ordnance firing circuits.

Proposed § 417.315 contains requirements for testing of a flight termination system and its components and documenting the results. A flight termination system's components would

be subjected to a comprehensive test program patterned after the approach developed at the federal launch ranges over many years of experience. This approach provides for demonstrating the reliability of flight termination system components and establishing an appropriate confidence level. The FAA worked extensively with Air Force flight termination system experts to refine the federal range testing requirements and develop the proposed regulatory requirements. A launch operator would employ flight termination system components that are tested in accordance with the qualification, acceptance, and age surveillance test requirements contained in proposed appendix E of part 417 as well as the preflight test requirements provided in proposed § 417.317.

Proposed § 417.317 contains requirements for preflight testing performed at the component level and the system level to be conducted at the launch site after qualification and acceptance testing to detect any change in performance that may have resulted from shipping, storage, or other environments that may have affected performance. Proposed § 417.317 also contains preflight test requirements for specific flight termination components, such as batteries, safe and arm devices, and command destruct receivers. All the preflight component test requirements being proposed by the FAA were developed in direct coordination with the Air Force based on the experience of range safety personnel in ensuring flight termination system reliability. The performance of some flight termination system components may degrade over time as they are exposed to various environments after installation on a launch vehicle. Proposed § 417.317 contains requirements that address at what point before flight such components would be required to undergo preflight tests, and also contains requirements for retesting if launch is delayed or if a subsystem or system is compromised due to a configuration change or other event such as a lightning strike or inadvertent connector mate or de-mate.

Proposed § 417.319 contains requirements for written flight termination system installation procedures. Installation procedures serve two purposes. They ensure the correct installation of flight termination system components so that the system will work as intended. They also serve the corollary purpose of addressing worker safety issues. Although, as discussed previously, the FAA has no current plans to duplicate OSHA's role in the area of worker safety, it nonetheless bears mentioning that, in establishing such procedures, a licensee may likely respond to worker safety requirements and concerns as well. The FAA proposes that a launch operator implement written procedures to ensure that flight termination system components, including electrical components and ordnance, are installed on a launch vehicle in accordance with the flight termination system design and that the installation of all mechanical interfaces associated with a flight termination system is complete.

Proposed § 417.321 contains requirements for monitoring critical flight termination system parameters to ensure that the status of a flight termination system can be ascertained and relayed to the appropriate launch operator personnel. The FAA would require that a launch operator establish pass/fail criteria for monitored flight termination system data to support launch abort decisions and to ensure a flight termination system is performing as expected.

Proposed § 417.323 contains requirements for a command control system which consists of the flight safety system elements that ensure that a command signal will reach a flight termination system on a launch vehicle during flight. A command control system includes all flight termination system activation switches at the flight safety official console, all intermediate equipment, linkages, and software and any auxiliary stations, and each command transmitting antenna. In short, it consists of the flight safety system components that are typically located on the ground; however, there are command control system concepts that involve air, sea, or even space borne elements. Section 417.323 would contain requirements for a command control system to be compatible with the flight termination system onboard the launch vehicle. For example, when a launch vehicle's onboard flight termination system is active and its ordnance is electrically connected, a command control system's transmitter must radiate at the proper frequency to capture the receivers on the flight termination system. Section 417.323 would also contain requirements for the reliability of a command control system, requirements for specific subsystems such as the transmitter and antenna, and general requirements for the system's performance.

Of particular interest is the requirement proposed in § 417.323(e)(5)(vi), namely, that a transmitter must operate at a radio carrier frequency authorized for the launch operator's use. Traditionally, licensed launches that take place at federal launch ranges have had access to government frequencies between 400–450 MHz because those frequencies are available to the federal launch ranges. As a result, flight safety system components, including command control system transmitters and receiver decoders, are often manufactured to operate on the available government frequencies. A launch that takes place at a non-federal launch site may or may not have access to those same frequencies. The FAA considered requiring that a launch operator always use the government frequencies for its flight safety system, but the FAA does not have authority to allocate spectrum or to authorize its use. The Federal Communications Commission (FCC) licenses and regulates commercial spectrum. A launch operator is likely to have to seek authorization from the FCC should it choose or need to use other frequencies for its flight safety system. Additionally, in the interests of permitting innovation, the FAA does not seek to foreclose the use of other frequencies.

Proposed § 417.325 contains test requirements for a command control system. The test requirements are not as demanding as for the airborne flight termination system because the command control system is not subjected to the rigors of a flight environment. Accordingly, the federal launch ranges do not require qualification testing to the environments required for flight units, and the FAA does not propose to expand upon the range requirements in this instance. Section 417.325 would contain requirements for a command control system, its subsystems, and components, to be subjected to acceptance and preflight tests and would provide general requirements that apply to all command control system testing, including requirements for documenting test results.

Proposed § 417.327 contains requirements for the additional subsystems that are part of an overall flight safety system. These subsystems are referred to as support systems because they support the flight safety official's ability to make a flight termination decision. Support systems would include vehicle tracking, visual data source, telemetry, communications, data display and data recording systems, the flight safety official console, and the launch timing system. Section 417.327 would require these support systems to be compatible with each other and would contain requirements applicable to each specific support system. Section 417.327 would also contain

requirements for support equipment calibration and a destruct initiator simulator that a launch operator would use when performing preflight tests of the flight termination system.

Of particular interest are the proposed requirements for a launch vehicle tracking system that provides continuous vehicle position and status data to the flight safety official from lift-off until the launch vehicle reaches orbit or can no longer reach any populated or other protected area. The FAA proposes launch vehicle tracking requirements for two, independent data sources, where at least one source is independent of any system used to aid the launch vehicle guidance system. Historically, the federal launch ranges have required three sources of tracking data regarding a vehicle's location, including telemetry and two additional independent sources for verification and back up. It is the FAA's understanding that the ranges require the second independent system for reasons of mission assurance and to avoid destroying what might have proven to be a normally functioning vehicle had additional tracking data been available to establish the fact. The FAA proposes to require one independent system to verify the accuracy of the launch vehicle's own telemetry. In light of the requirements proposed in § 417.113, which would require destruction of a vehicle when a launch operator loses tracking data, a launch operator may choose to follow the federal range practice of employing two independent tracking systems for the purpose of mission assurance. The FAA does not envision entertaining waiver requests for this requirement.

An independent tracking system would include a vehicle tracking aid onboard the launch vehicle, and compatible ground tracking system and onboard tracking system components. Onboard tracking system components, such as beacon transponders and GPS translators and their components must be independent of any system used to support the launch vehicle's inertial guidance system. Onboard tracking components that are not directly associated with determining or measuring vehicle position and performance constitute an exception to the requirement for independence. Examples of components that may be used by the vehicle telemetry system but that are not directly associated with determining or measuring vehicle position and performance include S-band down link antennas, transmitters, and associated cabling and power dividers.

When a flight safety system employs radar as an independent tracking source, the launch vehicle would be required to have a tracking beacon onboard the launch vehicle unless the launch operator provides a clear and convincing demonstration through the licensing process that any skin tracking maintains a tracking margin of no less than six dB above noise throughout the period of flight that the radar is used and that the flight control lines and flight limits account for the larger tracking errors associated with skin tracking. The proposed requirements for radar tracking follow current practice at the federal launch ranges for ensuring reliable and accurate radar tracking data.

The FAA weighed the possibility that a launch operator be permitted to use whatever secondary tracking source it desired, because proposed § 417.113's requirement to terminate flight in the event of a loss of telemetry would achieve the goal of keeping the launch vehicle from reaching the public. A number of reasons led the FAA to decide against such a proposal. As noted earlier, the federal launch ranges require three sources of vehicle tracking data: telemetry, radar, and backup radar. The FAA would require two sources, thereby reducing the tracking requirement at the start. Additionally, it is still important to have accurate tracking data because reliance on telemetry must be validated by some independent means, and because valid tracking data shows whether it is necessary to terminate flight. Finally, concerns over the unnecessary risks created by terminating flight also argue against permitting a less accurate means of tracking.

Proposed § 417.329 contains requirements for system analyses that a launch operator would perform to verify that a flight termination system, a command control system, and their components meet the reliability requirements of this proposed subpart. These analyses would be performed following standard industry system safety and reliability analysis methodologies. Guidelines for performing these analyses could be obtained through FAA Advisory Circular AC 431–01, a draft of which was made available April 21, 1999. Section 417.329 would contain requirements for the specific analyses and requirements for documenting the results.

Proposed § 417.331 contains requirements for a flight safety system crew and the roles and qualifications of crewmembers. A flight safety system would be operated by a flight safety crew made up of a flight safety official and support personnel. The flight safety crew positions and roles proposed by the FAA were developed based on the approach traditionally used at the federal launch ranges. Flight safety personnel who make up the flight safety crew are a critical link in the protection of the public from the hazards associated with launch, in particular assuring that a malfunctioning launch vehicle does not impact populated or other protected areas. Flight safety personnel are responsible for making instantaneous, irreversible, real time decisions that could affect the safety of public personnel and property. Highly qualified and skilled personnel must work as a team to operate a flight safety system in a highly efficient and reliable manner. The proposed standards for personnel qualifications and training would provide assurance that the personnel responsible for the flight safety system will meet the public safety related demands placed upon them.

The traditional approach to qualifying a flight safety crewmember at federal launch ranges primarily involves on-the-job-training. Candidates who possess an appropriate engineering and scientific education and technical experience may enter into an apprenticeship type of program under the cognizance of senior personnel who are responsible for training and evaluating performance. In the future, it may be possible for a launch operator to develop or obtain a formal flight safety training program. For example: NASA's Wallops Flight Facility has a flight safety official training curriculum developed for NASA's purposes and has, in the past, provided training for personnel outside of NASA. This type of training program might have to be tailored to meet a launch operator's specific needs and is expected to still involve a degree of hands on experience and evaluation to certify someone for a flight safety crew position. A person with previous federal range experience, who has successfully completed federal range training, and is certified to perform a flight safety function at a federal range, is likely to be qualified to perform that same function as a flight safety crew member for a launch from a non-federal launch site. Such crewmembers would still require training to familiarize them with the specific characteristics of the vehicle to be flown and the flight safety systems to be used for the launch. Initially, for launches from non-federal launch sites, the FAA appreciates that the flight safety crew positions would likely have to be filled by personnel with previous federal launch range experience or by personnel trained by the federal launch

ranges. At this time, a federal launch range is the primary source for the necessary training and experience. This is expected to change over time as the commercial launch industry continues to mature and experience at non-federal launch sites increases.

G. Part 417, Subpart E, Ground Safety

Proposed subpart E of part 417 contains safety requirements for launch processing and post-launch activities, typically referred to as ground safety requirements. Proposed § 417.401 describes the scope of subpart E. The requirements in subpart E would apply to launch processing and post-launch activities at a launch site in the United States that were performed by, or on behalf of, a launch operator. Launch processing and post-launch activities at a launch site outside the United States may be subject to the requirements of the governing jurisdiction.

Proposed § 417.403 contains requirements for a launch operator to ensure that the hazard controls necessary to protect the public are in place. The launch operator would perform a ground safety analysis, implement a ground safety plan, and conduct launch processing according to any local agreements. For a launch that is conducted from a launch site exclusive to its own use, a launch operator would be required to satisfy the requirements of subpart E and applicable requirements of part 420, which contains requirements that would govern a launch site operator. A launch operator would keep its ground safety plan current and provide the FAA with any change no later than 30 days before that change is implemented. When a launch operator is following procedures approved through the grant of a launch license the FAA does not seek to be advised of the changes in order to approve them but so that the FAA, when performing an inspection, knows, for example, where a hazard area is located for a specific operation. However, any change that involves the addition of a hazard that could affect the public or the elimination of any previously identified hazard control for a hazard that still exists, shall be submitted to the FAA for approval as a license modification.

Proposed § 417.405 would contain requirements for a launch operator to perform a ground safety analysis for all its launch vehicle hardware and launch processing at a U.S. launch site to identify each potential public hazard, any and all associated causes, and any and all hazard controls that a launch operator will implement to keep each hazard from reaching the public. § 417.405 would also contain the qualification requirements for personnel who prepare a ground safety analysis, identification of specific types hazards that would be addressed, and requirements for analyzing specific types of hazards.

Proposed § 417.407 contains requirements governing implementation of hazard controls and inspections to ensure that hazard controls are in place and no unsafe conditions exist.

Proposed § 417.409 contains requirements for a launch operator's implementation of the system hazard controls it identified through its ground safety analysis. For example, the FAA proposes to require that any system that presents a public hazard must be single fault tolerant. Also, each hazard control used to provide fault tolerance would be required to be independent so that no single action or event can remove more than one inhibit. A single command signal must not close two switches, if the two switches provide single fault tolerance. Switches, valves and similar actuation devices must be prevented from inadvertent actuation. § 417.409 would contain specific hazard control requirements for structures and material handling, pressure vessels and pressurized systems, electrical and mechanical systems, propulsion systems, and ordnance systems.

Proposed § 417.411 contains requirements for the establishment and control of safety clear zones for hazardous operations. A safety clear zone would be an area within which any potential adverse effect of a launch location hazard or public hazard will be confined. A launch operator would prohibit access by the public to any safety clear zone during a hazardous operation.

Proposed § 417.413 contains requirements for establishing and controlling hazard areas for each hardware system that presents a potential public or launch location hazard within which any adverse effects would be confined should an actuation or other undesirable hazardous event occur.

Proposed § 417.415 contains requirements for hazard controls for protecting the public after a launch or an attempted launch. A launch operator would implement procedures for controlling hazards and returning the launch facility to a safe condition after a successful launch attempt and in the event of a failed launch attempt where a solid or liquid launch vehicle engine start command was sent, but the launch vehicle did not liftoff. These procedures would include provisions for ensuring a flight termination system remained operational until it was verified that the launch vehicle did not represent a risk of inadvertent liftoff, assuring that the vehicle was in a safe configuration that included its propulsion and ordnance systems, and prohibiting launch complex entry until a pad safing team has performed all necessary safing tasks.

A launch operator would also implement procedural controls for hazards associated with an unsuccessful launch attempt where the launch vehicle has a land or water impact. The launch operator would provide for extinguishing any fires, evacuation and rescue of personnel, modeling and tracking of any toxic plume and communication with local government authorities, and securing impact areas to ensure that all personnel are evacuated, that no unauthorized personnel enter, and to preserve evidence. A launch operator would also provide for recovery and salvage of launch vehicle debris to ensure public safety and the safe disposal of any hazardous materials.

Proposed § 417.417 contains specific ground safety requirements for handling propellants and explosives during launch processing. A launch operator would comply with the explosive safety criteria and the explosive site plan developed for the launch site in accordance with 14 CFR part 420. A launch operator would implement procedures for the receipt, storage, handling and disposal of explosives and would implement its emergency response plan for the control of hazards in the event of a mishap associated with any propellant or explosive. Section 417.417 would also contain specific requirements for procedural system controls to preclude inadvertent initiation of explosives and propellants. These controls would include protection from stray energy sources such as static electricity, lightning, heat, and sources of spark and flame.

H. Appendix A, Methodologies for Determining Flight Hazard Areas for Orbital Launch

Appendix A of proposed part 417 would provide methodologies and equations used in determining flight hazard areas as part of the flight hazard area analyses required by proposed § 417.225. The establishment of flight hazard areas depends on calculating the dispersions associated with impacting debris and performing hit-probability calculations and making comparisons to established hit-probability criteria, such as the individual probability of casualty of 1×10^{-6} and the ship-hit criterion of 1×10^{-5}. There may be numerous ways to perform the hit-probability

calculations and to demonstrate meeting the established criteria. The methodologies in appendix A would provide a standard approach to which alternate methods could be compared and would assist in ensuring that the hit-probability criteria are implemented equally for all launches by all launch operators. The FAA proposes that a launch operator use the methodologies and equations provided in appendix A when performing the flight hazard area analyses unless, through the licensing process, the launch operator provides a clear and convincing demonstration that an alternative provides an equivalent level of safety.

With regards to the proposed requirements governing the creation of a specific hazard area, the FAA notes that a launch operator may anticipate that a hazard area established for one launch would likely apply to subsequent launches of the same vehicle on the same launch azimuth. A launch operator may demonstrate that earlier analyses applicable to launches with similar characteristics also may apply to later launches.

I. Part 417, Appendix B, Methodology for Performing Debris Risk Analysis

A launch operator shall use the equations and methodology contained in proposed appendix B when calculating expected casualty (E_C) due to debris as part of a debris risk analysis required by proposed §§ 417.227 and 417.235. The total E_C due to debris for a launch is calculated as the sum of the E_C due to planned debris impacts, the E_C due to potential launch vehicle failure during flight, which is referred to as overflight E_C, and any risk to populations due to potential failure of any flight termination system. A launch operator must include the E_C due to debris for a proposed launch when demonstrating that the launch does not exceed the overall E_C criterion of 30×10^{-6} for all hazards. As noted with regard to the flight hazard area analyses of appendix A, there may be numerous approaches to performing debris risk calculations as well. The methodology in appendix B would provide a standard approach to which alternate methods may be compared and would assist in ensuring that the debris risk overall E_C criterion is implemented equally for all launches by all launch operators. The FAA proposes that a launch operator use the methodology and equations provided in appendix B when performing the debris risk analysis unless through the licensing process, the launch operator provides a clear and convincing demonstration that another method or equation provides an equivalent level of safety. Further discussions on casualty due to debris and collective risk are contained in paragraphs III.E.8 and 9 of this preamble.

Of particular interest in appendix B is the proposed methodology for evaluating the risk to populations outside the flight control lines due to the potential failure of a flight safety system. Using the risk assessment tools employed by the Air Force, the FAA developed criteria for screening the populations in the areas surrounding a launch point and determining if further debris risk analysis would be necessary for a launch. The FAA's intent in developing the screening methodology was to simplify the analysis process for launches from relatively remote sites. For a launch that satisfied the screening criteria, a detailed risk analysis for populations outside the flight control lines would not be required.

When employing the screening criteria, a launch operator would divide the land areas around the launch point into sectors, determine the population in each sector, and compare those populations to the population limits established by the FAA for each sector. Proposed appendix B provides population limits for new and mature large launch vehicles and new and mature medium and small launch vehicles. The proposed population limits for a large launch vehicle were developed using computer models for a Titan 4. The computer models for an Atlas 2AS were used to develop the proposed population limits for medium and small launch vehicles. Failure rates that approximate the Titan 4 and Atlas 2AS failure rates based on their history of performance were used to represent the failure rates for mature launch vehicles. The overall failure rate for a new launch vehicle was assumed to be 0.31 as proposed in § 417.227(b)(6). Based on historical data on new launch vehicles, it was assumed that 15% of launch vehicle failures would occur during the first stage burn and 15% of those failures would result in impact outside the flight control lines if the flight safety system failed. The flight safety system was assumed to be in full compliance with the proposed requirements of subpart D of part 417 with a failure rate of 0.002.

J. Part 417, Appendix C, Flight Safety Analysis for an Unguided Suborbital Rocket Flown With a Wind Weighting Safety System and Flight Hazard Areas for Planned Impacts for All Launches

Appendix C of proposed part 417 would contain methodologies for performing the flight safety analysis required for the launch of an unguided suborbital rocket. The requirements in proposed appendix C for establishing ship and aircraft hazard areas for planned debris impact, such as for jettisoned spent stages and fairings, apply to all launches. The FAA proposes that a launch operator perform a flight safety analysis to determine the launch parameters and conditions under which an unguided suborbital rocket can be flown using a wind weighting safety system and without a flight safety system in accordance with proposed § 417.235. The results of this analysis would be required to show that any adverse effects resulting from flight would be contained within controlled operational areas, and that any flight hardware or payload impacts would occur within planned impact areas. The flight safety analysis must demonstrate compliance with the safety criteria and operational requirements for the launch of an unguided suborbital rocket contained in proposed § 417.125. The FAA would require that a launch operator ensure that the flight safety analysis for an unguided suborbital rocket be conducted in accordance with the methodologies provided in proposed appendix C unless the FAA approved alternative methods. Any alternative that meets the intent of the requirements of proposed appendix C may be submitted to the FAA through the licensing process, whether as part of an initial application for a license or as a request for a license modification, for evaluation of whether it satisfies the requirements of proposed § 417.235. A launch operator would also be required to perform a debris risk analysis for an unguided suborbital rocket launch in accordance with proposed § 417.227 and appendix B of part 417 and a conjunction on launch assessment in accordance with proposed § 417.233.

K. Part 417, Appendix D, Flight Termination System Components

Appendix D to proposed part 417 would contain requirements that apply to specific components of a flight termination system. Section D417.1(a) proposes that a launch operator ensure that the flight termination system requirements of proposed part 417, subpart D are met in conjunction with meeting the applicable component requirements of appendix D. The proposed requirements in appendix D were developed based on requirements traditionally used at federal launch ranges; however, the federal launch range requirements are not proposed in total. The FAA worked extensively with Air Force flight termination system experts to refine the requirements to a

performance level that eliminates the use of design solutions as requirements wherever possible, while maintaining the lessons learned over the many years of Air Force launch experience. The FAA proposes to require a launch operator to meet these requirements unless otherwise approved through the licensing process. The FAA would use these requirements as guidelines when evaluating an alternate flight termination system approach on a case-by-case basis. A launch operator would be required to demonstrate clearly and convincingly that any alternative provides a level of safety equivalent to the proposed requirements.

Section D417.1 (b) would require the design of each flight termination system component to provide for the component to be tested in accordance with § 417.315 and appendix E of proposed part 417.

Section D417.1 (c) would require that a launch operator ensure that compliance with each requirement in proposed appendix D is documented as part of a safety review document prepared during the licensing process according to § 415.107 of part 415. A licensee would submit any change to the FAA for approval as a license modification.

Proposed § D417.3 would contain requirements for the component design environments and the design margins above the maximum predicted environment levels that each flight termination system component must be capable of withstanding without degradation in performance. This section would define the environments and design margins for thermal, random vibration, shock, acceleration, acoustic and other environments to which the component could be exposed.

L. Part 417, Appendix E, Flight Termination System Component Testing and Analysis

Appendix E of proposed part 417 would contain testing requirements applicable to specific flight termination system components. The FAA proposes to require that flight termination system components be subjected to a comprehensive test program patterned after the approach developed at the federal launch ranges over many year of experience. This approach provides for demonstrating the reliability of flight termination system components and establishing an appropriate confidence in each component's reliability. The FAA worked extensively with Air Force flight termination system experts to refine the traditional requirements and develop the proposed regulatory requirements. What has resulted is both a reflection of current practice and an improvement intended to respond to launch operator requests for performance requirements. In response to the industry request for performance requirements, the FAA and the range safety personnel have attempted to capture the intent behind the ranges' flight termination system testing requirements. This creates an opportunity for flexibility on the part of the launch operator to employ different means of satisfying the performance driven test requirements. Both the FAA and the ranges believe that this represents an improvement over existing requirements. However, it does not, on a fundamental level represent a change from current requirements because both expressions of the requirements reflect the same goals. Performance requirements merely provide more flexibility in how one goes about achieving those goals.

Proposed appendix E would contain specific component, qualification, acceptance, and age surveillance tests to be implemented according to subpart D of proposed part 417. Compliance with proposed appendix E for each flight termination system component would be documented as part of a licensee's safety review document prepared according to proposed subpart F of part 415.

M. Part 417, Appendix, F, Flight Termination System Electronic Piece Parts

Appendix F of proposed part 417 would contain requirements for ensuring the quality of electronic piece parts used in flight termination system electronic components. The use of high quality electronic piece parts that perform consistently from one sampling of a part to the next is critical to ensuring the reliability of flight termination system components. The need for high quality parts becomes evident when reviewing the required approach for qualifying the design of a component and then building components for flight. When qualifying the design of a flight termination system component, a number of sample components are built and subjected to the required qualification tests. Qualification testing involves stressing a sample component beyond its intended operational environments to verify the required safety margins, and, in some cases, involves destructive testing and disassembly. Therefore, upon satisfying the qualification testing, a sample component must be retired and not used for flight. The use of high quality piece parts, which perform consistently from one sample part to the next, provides assurance that when the flight components are built they will be capable of the same performance that was demonstrated by the sample component that was qualification tested.

Piece parts may be purchased with different quality ratings depending on the amount of quality control and testing performed by the manufacturer to ensure that the parts perform with consistent reliability. Piece parts with a higher quality rating have a correspondingly higher price. A sample piece part with a lessor quality rating may in fact be just as reliable as a similar part with a higher rating, without, however, the assurances for consistent performance from one sample part to the next that come with the higher rating. Rather then just require that a launch operator purchase piece parts with a certain quality rating, the federal launch ranges have, within the past few years, developed an approach that allows a launch operator to upgrade the rating of an electronic piece part through testing. This allows the launch operator some options in selecting piece parts for a flight termination system while providing for an acceptable level of reliability assurance. The FAA worked in coordination with Air Force flight termination system experts to refine the piece part selection criteria and testing requirements and develop the proposed regulatory approach provided in appendix F. Proposed appendix F would contain requirements that address capacitors, connectors, diodes, transistors, hybrids, inductors, transformers, magnetic parts, microcircuits, resistors, and wire.

N. Part 417, Appendix G, Natural and Triggered Lightning Flight Commit Criteria

Proposed appendix G would provide flight commit criteria that protect against natural and triggered lightning during the flight of a launch vehicle. The FAA proposes to require a launch operator to implement these criteria in accordance with proposed § 417.113 for any launch vehicle that utilizes a flight safety system. The primary concern behind the proposed requirements is that a lightning strike that could disable a flight safety system yet allow continued flight of the launch vehicle without the ability to control flight termination. Criteria to guard against this eventuality were developed by a Lightning Advisory Panel composed of nationally recognized experts in the field of atmospheric electricity. (Revised 45 Space Wing Range Safety (Natural and Triggered Lightning) Weather Launch Commit Criteria, LCC–K 5/26/98) NASA and the Air Force chartered

this panel and have adopted these updated criteria for use at the federal launch ranges. These criteria cover a broad range of conditions, which apply to most launches at most launch sites; however, there may be exceptions. The FAA would require a launch operator to determine if any of these criteria do not apply to a planned licensed launch and provide the FAA with a justification during the licensing process in accordance with proposed § 415.115(e). The FAA proposes to approve a launch operator's flight commit criteria as part of the terms of a launch license.

O. Part 417, Appendix H, Safety Critical Computing Systems and Software

Proposed appendix H would contain safety requirements for all flight and ground systems for computing systems that perform or may perform any software safety critical function. The FAA would require a launch operator to ensure that any computing system with a software safety critical function associated with handling, preflight assembly, checkout, test, or flight of a launch vehicle, including any flight safety system, be implemented in accordance with the proposed appendix. The FAA proposes that software safety critical functions include, but need not be limited to the following: software used to control or monitor the functioning of safety critical hardware; software used or having the capability to monitor or control hazardous systems [17]; software associated with fault detection of safety critical hardware including software associated with fault signal transmission (faults shall include any manifestation of an error in software); software that responds to the detection of a safety critical fault; any software that is part of a flight safety system; processor interrupt software associated with safety critical software; and any software used to compute safety critical data. The FAA would require a launch operator to identify all software safety critical functions associated with its computing systems and software. For each software safety critical function, a launch operator would be required to define the boundaries of the associated system or software and implement the analysis, test, and other software validation requirements contained in this appendix. The requirements contained in proposed appendix H were adapted from the approach used successfully at the Air Force launch ranges and should therefore be familiar to current launch operators.

P. Part 417, Appendix I, Methodologies for Toxic Release Analysis

Proposed appendix I would provide methodologies for performing toxic release hazard analysis for the flight of a launch vehicle to contain the hazards or to determine whether risks created by toxic hazards remained within acceptable limits as identified in proposed § 417.107(b). Proposed appendix I would also provide methodologies for addressing the toxic hazards of launch processing at a launch site in the United States. For purposes of flight safety,[18] this appendix would prescribe a method for establishing flight commit criteria for each launch to protect the public from a casualty arising out of any potential toxic release during flight. A launch operator would first identify a toxic hazard area around the proposed launch point. The toxic hazard area would consist of a circle whose radius consisted of the greatest toxic hazard distance identified by the tables proposed in appendix I. If the toxic hazard area contained no members of the public, or if the launch operator were able to convince all members of the public to leave the toxic hazard area during flight through evacuation, the launch operator would be subject to no additional requirements under appendix I. If a launch operator were unable to avoid the presence of the public in the toxic hazard area, appendix I would require the launch operator to constrain preflight fueling and flight of a launch vehicle to times during which prevailing winds would transport any toxic release away from populated areas that would otherwise be at risk due to their presence within the toxic hazard area.

Current rocket propulsion systems require many pounds of chemical propellant for each pound of payload placed into orbit. Rocket motors rely on propellant combinations that consist of both fuel and oxidizer. Many of the chemical propellants currently in use are compounds that are toxic or produce toxic combustion byproducts. Among the toxic liquid propellants are the hydrazine based fuels: hydrazine, monomethylhydrazine (MMH) and unsymmetrical-dimethylhydrazine (UDMH). These fuels are toxic compounds and pose a potential air borne toxic hazard if spilled or released during a catastrophic failure of the launch vehicle. The hydrazine based fuels react with liquid oxidizers such as nitrogen tetroxide or nitric acid. These oxidizers are also toxic compounds and pose a potential hazard if spilled or released during a launch vehicle failure.

Solid propellants are also in common use in rocket motors and are often employed in conjunction with liquid propellant booster stages. Solid propellants are typically formulated from a mixture of solid fuel (such as, aluminum powder), solid oxidizer (such as, ammonium perchlorate) and polymeric binder (such as, PBAN). Most commercial launch vehicles use ammonium perchlorate (AP) based solid propellant. These AP based solid fuels are non-toxic in their solid state but produce approximately 20% by weight of toxic hydrogen chloride (HCl) gas as a combustion byproduct. Therefore the AP based fuels produce toxic emissions from both normal launch and abort scenarios. During launch vehicle processing, conditions may arise that will cause solid rocket propellant ignition or combustion, when, for instance a motor is dropped during movement or stacking, or static build up occurs on open grain propellant. Solid propellants using metal powders as the fuel also produce metal oxide particulates as a combustion by-product. Depending upon the size distribution and chemical composition, these particulates may also constitute a potential hazard.

Once released to the atmosphere, vaporized liquid propellants and gaseous propellant combustion products are subject to transport and diffusion by the local winds and atmospheric turbulence. Energy produced by the propellant chemical reactions may also cause the exhaust cloud to rise some distance above the initial release altitude. The quantity of material emitted, the height above ground of the emitted material, the prevailing weather conditions and the toxicity of the emitted chemicals are all factors affecting the hazard to people downwind of the release.

A launch operator's toxic release hazard analysis must determine any potential public hazards from any toxic release that will occur during the proposed flight of a launch vehicle or that would occur in the event of a flight mishap or that could occur during launch processing at the launch site in preparation for flight. A launch operator shall use the results of the toxic release

[17] The question may arise as to whether software used to monitor or control hazardous systems encompasses guidance software in light of its control of a launch vehicle's engines. The analysis of whether such software would be considered safety critical would have to address whether the launch vehicle relied on a flight safety system to terminate flight. If it did, the guidance software would likely not be treated as safety critical. If someone proposed to dispense with a flight safety system, the reliability of the software governing the guidance system would likely increase greatly in significance.

[18] Launch processing is addressed in greater detail in the discussion of subpart E of part 417.

hazard analysis to establish flight commit criteria for each launch and hazard controls for launch processing. A launch operator's toxic release hazard analysis must determine if toxic release can occur based on an evaluation of the propellants, launch vehicle materials, and estimated combustion products. This evaluation must account for both normal combustion products and the chemical composition of any unreacted propellants.

The FAA proposes that a launch operator evaluate potential toxic hazards in accordance with a multi-level screening approach in which the launch operator employs either exclusion, containment, or statistical risk management to prevent casualties that could arise out of exposure to any toxic release. The methodologies contained in appendix I for accomplishing this screening approach were developed based on the processes currently used at the Air Force launch ranges which have been highly successful in protecting the public from potential toxic release. The Air Force relies on sophisticated computer modeling to predict the dispersion of a toxic propellant in the atmosphere and its effect on the surrounding area. This type of modeling is available to a launch operator through the Air Force or commercially. It does, however, require significant expertise. The FAA worked in coordination with the Air Force, using the Air Force toxic release models to develop the proposed appendix I tables for determining hazard distances for potential release during the flight of a launch vehicle. The FAA believes the proposed containment methodology will work for a majority of launches. If not, a launch operator may elect to employ the more involved modeling and risk assessment techniques to demonstrate satisfaction of the risk criteria.

Paperwork Reduction Act

As required by the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 *et seq.*, the Federal Aviation Administration has reviewed the information collection requirements associated with this notice of proposed rulemaking. The FAA has determined that there would be no additional burden to respondents over and above that which the Office of Management and Budget has already approved under the existing rule, titled, ''Commercial Space Transportation Licensing Regulations'' (OMB control number 2120–0608). Under the existing rule, the FAA considers license applications to launch from non-federal sites on a case-by-case basis. In conducting a case-by-case review, the FAA gives due consideration to current practices in space transportation, generally involving launches from federal sites. Accordingly, the FAA believes that, under this proposed rule, there would be no additional information collection not already included in the previously approved information collection activity. This rule would eliminate the case-by-case review, thereby streamlining the licensing process, and would not place any additional burden on the respondent.

Regulatory Evaluation Summary

Changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each federal agency propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980, as amended March 1996, requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (19 U.S.C. 2531–25330 prohibit agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade Act also requires the consideration of international standards and, where appropriate, that they be the basis of U.S. standards. And fourth, the Unfunded Mandates Reform Act of 1995 requires agencies to prepare a written assessment of the costs, benefits and other effects of proposed or final rules that include a federal mandate likely to result in the expenditure by state, local or tribal governments, in the aggregate, or by the private sector, of $100 million or more. In conducting these analyses, the FAA has determined that this proposed rule: (1) Is not ''a significant regulatory action'' as defined in the Executive Order and in the Department of Transportation Regulatory Policies and Procedures; (2) will not have a significant impact on a substantial number of small entities; (3) will not impose restraints on international trade; and (4) does not contain any federal intergovernmental or private sector mandate. These analyses, available in the docket, are summarized below.

This proposed rule would codify the FAA's license application process for launch from a non-federal launch site. The proposed regulations are also intended to codify the safety requirements for launch operators regarding license requirements, criteria, and responsibilities in order to protect the public from the hazards of launch whether launching from a federal launch range or a non-federal launch site.

The FAA does not expect there to be any change in safety benefits. There may be some cost savings to the licensee because launch operators would have improved knowledge of the FAA license requirements, data and information requirements, and reporting requirements and formats beforehand. The FAA codified requirements will apply to all licensed commercial launches. Launch operators would know the FAA and federal range requirements, data and information requirements, and reporting requirements and formats. Finally, there may be some cost savings from launching at federal ranges since the launch operators would have improved knowledge of requirements.

The incremental cost of this proposal is expected to be at most, minimal. In general, there would be no change in costs to the licensee of satisfying the requirements of the proposed rulemaking. Costs would be the same whether licensing on a case-by-case basis or according to the proposed rulemaking.

In view of the minimal additional cost of compliance to the proposed rule, the FAA has determined that the proposed rule would be cost-justified.

Initial Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statues, to fit regulatory and informational requirements to the scale of the business, organizations, and governmental jurisdictions subject to regulation. To achieve that principal, the Act requires agencies to solicit and consider flexible regulatory proposals and to explain the rationale for their actions.'' The Act covers a wide-range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a proposed or final rule would have a significant economic impact on a substantial number of small entities. If the determination is that it will, the agency must prepare a regulatory flexibility analysis.

However, if an agency determines that a proposed or final rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the 1980 act provides that the head of the agency may so certify and a regulatory flexibility analysis is not required. The

FAA conducted the required review of this proposed rule and determined that it would not have a significant economic impact on a substantial number of small entities. Enactment of this proposal would impose, at most, only minimal cost. Accordingly, pursuant to the Regulatory Flexibility Act, 5 U.S.C. 605(b), the FAA certifies that this proposed rule will not have a significant economic impact on a substantial number of small entities.

International Trade Impact Assessment

The Trade Agreement Act of 1979 prohibits federal agencies from promulgating any standards or engaging in any related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and where appropriate, that they be the basis for U.S. standards. In addition, consistent with the Administration's belief in the general superiority and desirability of free trade, it is the policy of the Administration to remove or diminish to the extent feasible, barriers to international trade, including both barriers affecting the export of American goods and services to foreign countries and barriers affecting the import of foreign goods and services into the United States.

In accordance with the above statute and policy, the FAA has assessed the potential effect of this proposed rule and has determined that it would impose the same costs on domestic and international entities and thus has a neutral trade impact.

Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. The FAA has determined that this action will not have a substantial direct effect on the states, on the relationship between the national U.S. Government and the states, or on the distribution of power and responsibilities among the various levels of government. Therefore, the FAA has determined that this final rule does not have federalism implications.

Unfunded Mandates

The Unfunded Mandates Reform Act of 1995 (UMRA), enacted as Pub. L. 104–4 on March 22, 1995, is intended, among other things, to curb the practice of imposing unfunded federal mandates on state, local, and tribal governments.

Title II of the Act requires each federal agency to prepare a written statement assessing the effects of any federal mandate in a proposed or final agency rule that may result in a $100 million or more expenditure (adjusted annually for inflation) in any one year by state, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.''

This proposed rule does not contain such a mandate. Therefore, the requirements of Title II of the Unfunded Mandates Reform Act of 1995 do not apply.

Environmental Assessment

The FAA has determined that the proposed amendments to the commercial space transportation licensing and safety rules are categorically excluded from environmental review under 102(2)(C) of the National Environmental Policy Act (NEPA). The proposed rules, which address obtaining and maintaining a license, are administrative and procedural in nature and are therefore categorically excluded under FAA Order 1050.1D, appendix 4, paragraph 4(i). In addition, part 415 already requires an applicant to submit sufficient environmental information for the FAA to comply with NEPA and other applicable environmental laws and regulations during the processing of each license application, thereby ensuring that any significant adverse environmental impacts from licensing commercial launches will be considered during the application process. Accordingly, the FAA has determined that this rule is categorically excluded because no significant impacts to the human environment will result from finalization or implementation of its administrative and procedural provisions for licensing commercial launches.

Energy Impact

The energy impact of the rulemaking action has been assessed in accordance with the Energy Policy and Conservation Act (EPCA) and Public Law 94–163, as amended (42 U.S.C. 6362). It has been determined that it is not a major regulatory action under the provisions of the EPCA.

List of Subjects

14 CFR Part 413

Confidential business information, Space transportation and exploration, Reporting and recordkeeping requirements.

14 CFR Part 415

Rockets, Space transportation and exploration.

14 CFR Part 417

Aviation safety, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend parts 413, 415 and 417 of Chapter III, Title 14, Code of Federal Regulations as follows:

PART 413—LICENSE APPLICATION PROCEDURES

1. The authority citation for part 413 continues to read as follows:

Authority: 49 U.S.C. 70101–70121.

2. Amend § 413.7 by adding paragraph (d) to read as follows:

§ 413.7 Application.

* * * * *

(d) *Measurement system consistency.* For each analysis, an applicant must employ a consistent measurements system, whether English or metric, in its application and licensing information.

PART 415—LAUNCH LICENSE

3. The authority citation for part 415 continues to read as follows:

Authority: 49 U.S.C. 70101–70121.

4. Revise § 415.1 to read as follows:

Subpart A—General

§ 415.1 Scope.

This part prescribes requirements for obtaining a license to launch a launch vehicle, other than a reusable launch vehicle, and post-licensing requirements with which a licensee shall comply to remain licensed. Post-licensing requirements governing launch from a federal launch range or a non-federal launch site are also contained in part 417 of this subchapter. Requirements for preparing a license application are contained in part 413 of this chapter.

5. Amend § 415.51 to add the following sentence to the end of the section: ''All payloads, exempt or not, are subject to the safety requirements of subparts C and F of this part and of part 417 of this chapter.''

6. In § 415.73, amend paragraph (b)(2) by removing the words ''submitted in accordance with subpart D of this part''.

7. Redesignated §§ 415.101 and 415.103 as §§ 415.201 and 415.203, respectively.

8. Revise subpart F to read as follows:

Subpart F—Safety Review and Approval for Launch of an Expendable Launch Vehicle From a Non-Federal Launch Site

Sec.
415.91–415.100 [Reserved]
415.101 Scope.
415.103 General.
415.105 Pre-application consultation.
415.107 Safety review document.
415.109 Launch description.
415.111 Launch operator information.
415.113 Launch personnel certification program.
415.115 Flight safety.
415.117 Ground safety.
415.119 Launch plans.
415.121 Launch schedule and points of contact.
415.123 Computing systems and software.
415.125 Unique safety policies and practices.
415.127 Flight safety system design and operation data.
415.129 Flight safety system testing data.
415.131 Flight safety system crew data.
415.132–415.200 [Reserved]

Subpart F—Safety Review and Approval for Launch of an Expendable Launch Vehicle From a Non-Federal Launch Site

§§ 415.91–415.100 [Reserved]

§ 415.101 Scope.

(a) This Subpart F contains requirements that a launch operator must meet as part of the safety review process when applying for a license to launch an expendable launch vehicle from a non-federal launch site. This subpart identifies specific tasks that an applicant must complete and identifies the safety review material that an applicant must submit. This subpart also covers all administrative requirements, such as when and how the data is to be submitted, as well as the requirements for the form and content of each data submission.

(b) The requirements in this subpart apply to orbital launch vehicles and guided and unguided suborbital launch vehicles. Requirements in §§ 415.103 through 415.125 apply to all proposed launches of expendable launch vehicles. Sections 415.127 through 415.131 contain the flight safety system related requirements and apply to all expendable launch vehicles that use a flight safety system to ensure public safety.

(c) Material submitted to the FAA under this subpart measures an applicant's ability to comply with the launch operator responsibilities and technical requirements in part 417 of this chapter. The related requirements in part 417 are referenced in this subpart where applicable. To facilitate production of the safety review material required by this subpart, an applicant must first become familiar with the launch operator requirements in part 417 of this chapter.

§ 415.103 General.

(a) The FAA conducts a safety review as part of the licensing process to determine whether a launch license applicant will conduct launch processing and flight without jeopardizing public health and safety and safety of property. The FAA issues a safety approval if the applicant satisfies the requirements of this subpart and demonstrates, through the safety review process of this subpart, that it will meet the safety responsibilities and requirements for launch contained in part 417 of this chapter.

(b) The FAA advises an applicant, in writing, of any issue raised during a safety review that would impede issuance of a safety approval. The applicant may respond, in writing, or amend its license application in accordance with § 413.17 of this chapter.

(c) An applicant shall make available to the FAA upon request a copy of any record required by this subpart including any material incorporated into a license application by reference.

§ 415.105 Pre-application consultation.

(a) An applicant shall participate in no less than one pre-application consultation meeting at FAA headquarters when planning to apply for a new launch license. The purpose of the consultation is to review the proposed launch and obtain direction from the FAA related to the licensing process.

(b) When applying for a new launch license, a pre-application consultation meeting must be conducted no later than 24 months before an applicant brings any launch vehicle to the proposed launch site and before the applicant begins preparation of the initial flight safety analysis required by § 415.115. An applicant may request additional pre-application consultation meetings.

(c) At a pre-application consultation meeting, an applicant shall provide as complete a description of the planned launch as is available at the time. Data presented by an applicant to the FAA during a pre-application consultation meeting must include, but need not be limited to, the following:

(1) *Launch vehicle.* A launch vehicle description, the planned trajectory and flight azimuth, a description of any flight termination system, and a description of all hazards associated with the launch vehicle and any payload, including the type and amounts of all propellants, explosives, toxic materials and any radionuclides.

(2) *Proposed mission.* The apogee, perigee, and inclination of any orbital objects and any stage or other component impact locations.

(3) *Potential launch site.* The name and location of the proposed launch site, including latitude and longitude, and identity of any launch site operator of that proposed site and identification of any facilities at the launch site that will be used for launch processing and flight.

§ 415.107 Safety review document.

(a) A license applicant shall submit a safety review document that contains all the information required by this subpart for the FAA to conduct a launch safety review during the licensing process. An applicant shall comply with the scheduling requirements of part 417 of this chapter and this subpart. This subpart contains requirements for an applicant to submit certain data by a specified time during the licensing process. An applicant shall submit a sufficiently complete safety review document no later than six months before the applicant brings any launch vehicle to the proposed launch site.

(b) An applicant shall submit the data required for a safety review document in accordance with the outline in appendix B of this subpart. Sections 415.109 through 415.131 of this subpart provide the requirements for the content of each section of a safety review document. Related technical requirements and requirements governing a launch operator's implementation of the safety provisions described in its safety review document are provided in part 417 of this chapter. A launch operator's safety review document must be in accordance with the following:

(1) A safety review document must contain a glossary of unique terms and acronyms used listed in alphabetical order.

(2) A safety review document must contain a listing of all referenced standards, codes, and publications.

(3) A safety review document must be logically organized, with a clear and consistent page numbering system and with cross-referenced topics clearly identified.

(4) All text in a safety review document must be in English. If supplemental information is originally in a language other than English, the launch operator shall provide the FAA with an accurate and complete translation.

(5) All equations and mathematical relationships contained in a safety review document must be derived or referenced to a recognized standard or text and all algebraic parameters shall be clearly defined.

(6) The units of all numerical values shall be included in a safety review document.

(7) Any schematic diagrams contained in a safety review document shall include a legend or key that identifies all symbols used.

(c) An applicant's safety review document may include sections not required by appendix B of this part. An applicant shall identify each such section by using the word ''ADDED'' preceding the title of the added section. In the first paragraph of the added section, an applicant shall provide a description and justification for the circumstances that require an addition to the appendix B outline.

(d) There may be safety review document sections specified in appendix B of this part that are not applicable to an applicant's proposed launch. An applicant shall identify such sections in the application by the words ''NOT APPLICABLE'' preceding the title of the section. An applicant shall demonstrate why the section is not applicable.

(e) An applicant may reference documentation previously submitted to the FAA in a safety review document.

(f) An applicant shall submit one bound paper copy, one unbound paper copy, and an electronic copy of a safety review document as part of a license application.

(1) Paper copies must be on standard letter size paper, 8.5 × 11 inches. Larger paper may be used where needed for charts and graphs, but must be folded to 8.5 × 11 inches. The body text type font size shall be 12 points.

(2) The electronic copy must be in a data format compatible with commercial word processing software.

§ 415.109 Launch description.

(a) *General.* An applicant's safety review document must describe each proposed launch or series of launches in accordance with the requirements of this section.

(b) *Purpose.* An applicant's safety review document must describe the purpose of each proposed launch or series of launches and identify each launch vehicle, each payload, and any payload customer.

(c) *Launch schedule.* An applicant's safety review document must identify each planned flight date and time and each alternate date and time. For the licensing of more than one launch, an applicant shall submit schedule information for the earliest planned launch and best estimates for each subsequent launch.

(d) *Launch site description.* An applicant's safety review document must describe the proposed launch site and identify the following:

(1) All launch site boundaries;

(2) Launch point location, including latitude and longitude;

(3) Average weather conditions for the launch period;

(4) Major geographic features within 100 nautical miles of the launch point, including federal, state, local and any foreign territorial boundaries, elevations, rivers, lakes, canals, bridges, roadways, railroads, towns and cities, vessel ports, and airports; and

(5) Major shipping and aircraft routes within 100 nautical miles of the launch point.

(e) *Launch vehicle description.* An applicant's safety review document must describe the proposed launch vehicle. An applicant shall submit a written description and a drawing of the launch vehicle that identifies major stages, physical dimensions, the location of any flight termination system hardware, and the location of any tracking aids. The drawing must also identify the location of major vehicle control systems, propulsion systems, pressure vessels, and any other hardware that contains potential hazardous energy or hazardous material. The launch vehicle description must include a table specifying the type and quantities of all hazardous materials including propellants, explosives, and toxic materials.

(f) *Payload description.* An applicant's safety review document must contain, or reference documentation previously submitted to the FAA that contains, the payload information required by § 415.59 for any payload in accordance with part 415, subpart D. The safety review document must also contain a table specifying the type and quantities of all hazardous materials within each payload.

(g) *Trajectory.* An applicant's safety review document must contain two drawings depicting trajectory information. One drawing must depict the proposed nominal flight profile with downrange depicted on the abscissa and altitude depicted on the ordinate axis. The nominal flight profile must be labeled to show each planned staging event and its time after liftoff from launch through orbital insertion or final impact. The second drawing must depict instantaneous impact point ground traces for each of the nominal trajectory, the three-sigma left lateral trajectory and the three-sigma right lateral trajectory determined in accordance with § 417.205 of this chapter. The trajectories must be depicted on a latitude/longitude grid, and the grid must include the outlines of any continents and islands. An applicant shall submit additional trajectory information as part of the flight safety analysis data required by § 415.115.

(h) *Staging events.* An applicant's safety review document must contain a table of nominal and ± three-sigma times for each major staging event and a description of each event, including the predicted impact point and dispersion of each spent stage.

(i) *Vehicle performance graphs.* An applicant's safety review document must contain graphs of the nominal and ± three-sigma values as a function of time after liftoff for the following launch vehicle performance parameters: thrust, altitude, velocity, instantaneous impact point arc-range measured from the launch point, and present position arc-range measured from the launch point.

(j) *Unguided suborbital rocket.* For launch of an unguided suborbital rocket, in addition to the other applicable data requirements contained in this section, an applicant's safety review document must describe the rocket design configuration. The description must include:

(1) Construction materials and assembly of rocket body and control surfaces;

(2) Physical dimensions and weight;

(3) Propulsion and safety critical systems; and

(4) Location of the unguided suborbital rocket's center of pressure in relation to its center of gravity for the entire flight profile.

§ 415.111 Launch operator information.

(a) *Launch operator administrative information.* An applicant's safety review document must contain, or reference documentation previously submitted to the FAA that contains, the launch operator administrative information required by § 413.7(b) of this chapter.

(b) *Launch operator organization.* An applicant's safety review document must describe the applicant's organization established to ensure public safety and satisfy the requirements of part 417 of this chapter. The safety review document must describe the launch management positions and launch team organizational elements established by the applicant as required by § 417.103 of this chapter. An applicant's internal management positions and

organizational elements shall be identified as such and any contractors to the applicant shall be identified as such. An applicant's safety review document must contain organizational charts and written text that identify and describe:

(1) All launch management positions.

(2) All launch team organizational elements.

(3) The lines of communication and approval authority for launch safety decisions.

(4) The specific safety functions performed by each launch management position and organizational element.

§ 415.113 Launch personnel certification program.

(a) A safety review document must describe how the applicant will satisfy the personnel certification program requirements of § 417.105 of this chapter and identify by position those individuals who implement the program.

(b) An applicant's safety review document must contain a copy of any program documentation used to implement the personnel certification program.

(c) An applicant's safety review document must contain a table listing each hazardous operation or safety critical task that certified personnel must perform. For each task, the table must identify by position the individual who reviews personnel qualifications and certifies personnel for performing the task.

§ 415.115 Flight safety.

(a) *Flight safety analysis.* An applicant shall perform flight safety analysis for a proposed launch or proposed series of launches in accordance with subpart C of part 417 of this chapter. An applicant's safety review document must contain analysis products and other data that demonstrate the applicant's ability to meet the public risk criteria in § 417.107 of this chapter and to establish launch safety rules in accordance with § 417.113 of this chapter. An applicant's flight safety analysis must satisfy the following requirements:

(1) An applicant shall submit the flight safety analysis data required by this section no later than 18 months before the applicant brings any launch vehicle to the proposed launch site.

(2) The flight safety analysis performed by an applicant must be completed as specified in subpart C of part 417 of this chapter. An applicant may identify those portions of the analysis that it expects to refine as the first proposed flight date approaches. An applicant shall identify any analysis product subject to change, describe what needs to be done to finalize the product, and identify when before flight it will be finalized. If a license is for more than one launch, an applicant shall provide a discussion on the applicability of the analysis methods to each of the proposed launches and identify any expected differences in the flight safety analysis methods among the proposed launches. Once licensed, a launch operator is required to perform flight safety analysis for each launch using final launch vehicle performance and other data in accordance with subpart C of part 417 of this chapter and using the analysis methods approved by the FAA through the licensing process or as a license modification.

(3) An applicant's safety review document must describe each analysis method employed to meet the analysis requirements of part 417, subpart C of this chapter. An applicant's safety review document must contain the analysis products for each of the analyses required by part 417, subpart C of this chapter for each proposed launch. An applicant's safety review document must contain the following data for each analysis product:

(i) A discussion and justification of any assumptions made by the applicant when performing the analysis; and

(ii) A sample of each flight safety analysis computation showing input data and processing algorithms leading to the required analysis products.

(b) *Conjunction on launch assessment.* An applicant's safety review document must contain conjunction on launch assessment input data for the first proposed launch. The input data submitted as part of a license application must satisfy the requirements of § 417.233 of this chapter. An applicant need not obtain a conjunction on launch assessment from United States Space Command prior to being issued a license.

(c) *Radionuclides.* An applicant's safety review document must identify the type and quantity of any radionuclide on a launch vehicle or payload. For each radionuclide, an applicant's safety review document must contain a reference list of all documentation addressing the safety of its intended use and describe all approvals by the Nuclear Regulatory Commission for launch processing. An applicant shall provide radionuclide information to the FAA at pre-application consultation in accordance with § 415.105. The FAA will evaluate launch of any radionuclide on a case-by-case basis, and issue an approval if the FAA finds that the launch is consistent with public health and safety.

(d) *Flight safety plan.* An applicant's safety review document must contain a flight safety plan that identifies the flight safety roles to be performed by the applicant's flight safety personnel; the flight safety rules, limits, and criteria identified by an applicant's flight safety analysis; and the specific flight safety requirements of part 417 of this chapter to be implemented for launch. The flight safety plan need not be restricted to public safety related issues and may combine other flight safety issues as well, such as employee safety, so as to be all-inclusive. A flight safety plan must include, but need not be limited to, the following:

(1) *Flight safety personnel.* Identification of personnel by position who approve and implement each part of the flight safety plan and any modifications to the plan. Identification of personnel by position who perform the flight safety analysis and ensure that the results, including the flight safety rules and establishment of flight hazard areas, are incorporated into the flight safety plan.

(2) *Flight safety rules.* Flight safety rules required by § 417.113 of this chapter.

(3) *Flight safety system.* A description of any flight safety system and its operation, including any preflight flight safety system tests to be performed.

(4) *Trajectory and debris dispersion data.* A description of the launch trajectory, including planned orbital parameters, stage burnout times and state vectors, and planned stage impact times, locations, and downrange and crossrange dispersions.

(5) *Flight hazard areas and safety clear zones.* Identification and location of the flight hazard areas and safety clear zones established for each launch in accordance with § 417.225 of this chapter, and identification of procedures for surveillance and clearance of these areas and zones as required by § 417.121(f).

(6) *Support systems and services.* Identification of any support systems and services to be implemented as part of ensuring flight safety, including any aircraft and ships and procedures that will be used during flight.

(7) *Flight safety operations.* A description of the flight safety related tests, reviews, rehearsals, and other flight safety operations to be conducted in accordance with §§ 417.115 through 417.121 of this chapter. A flight safety plan must contain or incorporate by reference written procedures for accomplishing all flight safety operations.

(e) *Natural and triggered lightning.* An applicant shall demonstrate that it will

satisfy the flight commit criteria required by § 417.113(b)(5) of this chapter and appendix G of part 417 of this chapter for natural and triggered lightning. If an applicant's safety review document states that any flight commit criterion that is otherwise required by appendix G of part 417 of this chapter does not apply to a proposed launch, the applicant's safety review document must demonstrate that the criterion does not apply.

(f) *Unguided suborbital rockets.* For the launch of an unguided suborbital rocket, the flight safety data submitted in an applicant's safety review document must meet the requirements of this section and demonstrate compliance with the requirements contained in § 417.125 and § 417.235 of this chapter. An applicant's flight safety plan for the launch of an unguided suborbital rocket must meet the requirements in paragraph (d) of this section and provide the following data:

(1) Launch angle limits;

(2) Procedures for measurement of launch day winds and for performing wind weighting in accordance with §§ 417.125 and 417.235 of this chapter;

(3) Flight safety personnel qualifications and roles for performing wind weighting; and

(4) Procedures for any recovery of a launch vehicle component or payload.

§ 415.117 Ground safety.

(a) *General.* An applicant shall submit a ground safety analysis report and ground safety plan for its launch processing and post-launch operations in accordance with this section when launching from a launch site in the United States. Launch processing and post-launch operations at a launch site outside the United States may be subject to the requirements of the governing jurisdiction.

(b) *Ground safety analysis report.* An applicant shall perform a ground safety analysis of its launch processing and post-launch operations in accordance with subpart E of part 417 of this chapter. As part of its safety review document, an applicant shall submit a ground safety analysis report that reviews each system and operation used in launch processing and post-launch operations, and identifies all public hazards and the controls to be implemented to protect the public from each hazard. The ground safety analysis report must describe each of the launch operator's systems and operations and show that all hazards that could affect the public have been identified and controlled. A hazard that could affect the public is any hazard with an effect that may extend beyond the launch personnel doing the work and that has the potential to reach the public, regardless of where members of the public are located. An applicant shall perform a ground safety analysis in accordance with the requirements in part 417, subpart E of this chapter. This section contains requirements for the ground safety analysis report to be submitted in support of an applicant's safety review.

(1) An applicant shall submit an initial ground safety analysis report no later than 12 months before the applicant brings any launch vehicle to the proposed launch site. An initial ground safety analysis report must be in a proposed final or near final form and identify any incomplete items. An applicant shall document any incomplete items and track them to completion. An applicant shall resolve any FAA comments on the initial report and submit a complete ground safety analysis report, no later than two months before the applicant brings any launch vehicle to the proposed launch site. Furthermore, an applicant shall ensure that its ground safety analysis report is kept current. Any late developing change to a ground safety analysis report shall be coordinated with the FAA as an application amendment in accordance with § 413.11 of this chapter as soon as the need for the change is identified.

(2) An applicant shall submit a ground safety analysis report in accordance with the format and content requirements of appendix C of this part.

(3) All information in a ground safety analysis report must be verifiable, including design margins, fault tolerance and successful completion of tests. Any identified hardware must be traceable to an engineering drawing or other document that describes hardware configuration. Any test or analysis identified must be traceable to a report or memorandum that contains details about how the test or analysis was performed and the results and identifies those who ensure the accuracy of the test or analysis. Any procedural hazard control identified must be traceable to a written procedure, approved by the launch safety director or designee, with the paragraph or step number of the procedure specified. A verifiable hazard control shall be identified for each hazard. For each hazard control the report must reference a released drawing, report, procedure or other document that verifies the existence of the hazard control. A launch operator shall maintain records, in accordance with § 415.77, of the verification documentation that supports the information in the ground safety analysis report.

(4) Any text describing a sequence of events or multiple pieces of information must be provided in the form of numbered lists. An applicant's ground safety analysis report must contain figures to illustrate systems and aid understanding of the data provided in the text, such as sketches to show dimensions and configuration, and schematics that show how systems function and how fault tolerance is provided. Facility drawings shall be provided to illustrate where operations take place and how public access to a hazard area would be controlled.

(5) A ground safety analysis report must be approved and signed by the launch safety director and the launch director. Each individual who prepares any part of a ground safety analysis report, shall sign and date a written statement certifying that the part of the report that person prepared is true, complete and accurate as of that date. Each statement must be included as part of the report or as an attachment.

(c) *Ground safety plan.* An applicant's safety review document must contain a ground safety plan that describes the ground safety roles to be performed by launch personnel and the ground safety rules and procedures to be implemented to protect public safety. This plan must describe implementation of the hazard controls identified by an applicant's ground safety analysis and implementation of the ground safety requirements of subpart E of part 417 of this chapter. A ground safety plan must address all public safety related issues and may include other ground safety issues if an applicant intends it to have a broader scope. A ground safety plan must include, but need not be limited to, the following:

(1) A description of the launch vehicle and payload identifying all hazards, including explosives, propellants, toxics and other hazardous materials, radiation sources, and pressurized systems. A ground safety plan must include figures that show the location of each hazard on the launch vehicle and where at the launch site, launch processing involving the hazard is performed.

(2) Propellant and explosive information including:

(i) Total net explosive weight of the launch operator's propellants and explosives for each explosive hazard facility as defined in part 420 of this chapter;

(ii) For toxic propellants, any hazard controls and process constraints determined in accordance with the launch operator's toxic release hazard

analysis for launch processing performed in accordance with § 417.229 and appendix I of part 417 of this chapter.

(iii) The facility explosive and occupancy limits;

(iv) Individual explosive item data, including configuration (such as, solid motor, motor segment, or liquid propellant container), explosive material, net explosive weight, storage hazard classification and compatibility group as defined in part 420 of this chapter;

(3) A graphic depiction of the layout of the launch operator's launch complex and other launch processing facilities at the launch site. The depiction must show separation distances and any intervening barriers between explosive items that affect the total net explosive weight that each facility is sited to accommodate. An applicant shall identify any proposed facility modifications or operational changes that may affect a launch site operator's explosive site plan.

(4) A description of the process for ensuring that any procedures and procedure changes are reviewed for safety implications and are approved by a launch operator's launch safety director or designee.

(5) Procedures that launch personnel will follow when reporting a hazard or mishap to the launch operator's safety organization.

(6) Procedures for ensuring that personnel have the qualifications and certifications needed to perform a task involving a hazard that could affect public safety.

(7) A summary of the means for announcing when any hazardous operation is taking place, the means for making emergency announcements and alarms, and identification of the recipients of each type of announcement.

(8) A summary of the means of implementing access control to safety clear zones and hazard areas, including any procedures for allowing public access to such areas.

(9) General ground safety rules.

(10) A description of the process for ensuring that all safety precautions and verifications are in place prior to, during, and after hazardous operations. This includes the process for verification that an area can be returned to a non-hazardous work status.

(11) A flow chart of launch processing and a list of all major tasks. This must include all hazardous tasks and an identification of where and when, with respect to liftoff, they will take place.

(12) Identification of safety clear zones and hazard areas established in accordance with § 417.411 of this chapter.

(13) A description of the hazard controls and required verifications, in accordance with the ground safety analysis, for each task that creates a public hazard, including procedures for implementing any safety clear zones for the protection of the public.

(14) For each task that creates a public hazard, a procedure for the use of any safety equipment that protects the public.

(15) For each task creating a hazard that could affect the public, the requirements and procedures for coordinating with any launch site operator and local authorities.

(16) Generic emergency procedures that apply to all emergencies and the emergency procedures that apply to specific tasks that may create a public hazard including any task that involves a hazardous material as described in § 417.407 of this chapter.

(17) A listing of safety documentation, by title and date, which supplements the data provided in the ground safety plan, such as the ground safety analysis report, explosive quantity-distance site plan and other ground safety related documentation.

§ 415.119 Launch plans.

(a) *General.* In addition to the flight and ground safety plans required by § § 415.115 and 415.117, an applicant's safety review document must contain the public safety related launch plans required by this section. Each plan must identify operation personnel and their duties, contain mission specific information for the first planned launch and include written procedures that contain the specifics of the operations and activities conducted in accordance with the plan. Procedures may be incorporated by reference. Each plan must identify personnel by position who approve and implement the plan, the related procedures, and any modification to the plan or procedures. An applicant shall incorporate each launch safety rule established in accordance with § 417.113 of this chapter into each related launch safety plan. An applicant's launch plans shall include, but need not be limited to, those required by this section.

(b) *Emergency response plan.* An applicant's safety review document must contain an emergency response plan that ensures public safety in the event of a mishap during launch processing or flight. An emergency response plan must identify emergency response personnel and their duties and describes the methods to be used to ensure public safety. An emergency response plan must define the process for providing assistance to any injured people and describe the methods used to control any hazards associated with a mishap. An emergency response plan must describe the types of emergency support required, equipment to be used, emergency response personnel and their qualifications, and any related agreements with any launch site operator and state, county or local government agencies. The types of emergency support described in the plan shall include, but need not be limited to, firefighting, explosive ordnance disposal, chemical spill response, and medical support.

(c) *Accident investigation plan.* An applicant's safety review document must contain an accident investigation plan that meets the requirements of § 415.41 of this part. The accident investigation requirements for launch from a federal launch range in part 415, subpart C also apply to launch from a non-federal launch site.

(d) *Launch support equipment and instrumentation plan.* An applicant's safety review document must contain a launch support equipment and instrumentation plan that ensures the reliability of the equipment and instrumentation that is involved in ensuring public safety during launch processing and flight. A launch support equipment and instrumentation plan must list and describe such equipment and must identify personnel who are responsible for its operations and maintenance and who must be certified in accordance with § 417.105 of this chapter. The plan must also contain, or incorporate by reference, written procedures for support equipment operation, test, and maintenance that are to be implemented for each launch. The plan must also identify equipment and instrumentation reliability and contingencies that protect the public in the event of a malfunction.

(e) *Configuration management and control plan.* A safety review document must contain a configuration management and control plan for all safety critical system, such as, any flight safety system and any launch processing system that represents a hazard to the public. A configuration management and control plan must define the applicant's process for managing and controlling any change to a safety critical system to ensure its reliability. For each system, the plan must identify each person with authority for approving design changes as well as the personnel, by position, who maintain documentation of the most current approved design. This plan must contain, or incorporate by reference, all

configuration management and control procedures that apply to the launch vehicle and each support system.

(f) *Communications plan.* An applicant's safety review document must contain a communications plan that ensures clear concise communications between personnel involved in launch processing, countdown, and flight. A communications plan must list and describe all forms of communication that ensure public safety and any voice and data circuits required to allow real-time interface among launch control and safety personnel for each task during the conduct of hazardous operations, launch processing, countdown, and flight. This includes communications to locations outside of the launch site boundaries when those communications are necessary for public safety and includes those communications that are part of any flight safety system as required by § 417.327 of this chapter. A communications plan must delineate clear lines of communication and unimpeded flow of reporting and direction. The plan must define precise and formal communication protocols using well-defined terminology and acronyms that can be clearly understood over a voice network. The communications plan must also identify communication system reliability and backup circuits.

(g) *Frequency management plan.* An applicant's safety review document must contain a plan that identifies the radio frequencies used in support of a launch and the process for allocating use of those frequencies for each operation performed during launch processing and flight to avoid interference, and must identify and provide contact information for the personnel who implement the plan. A frequency management plan must:

(1) Identify each frequency, allowable frequency tolerances, and each frequency's intended use, operating power, and source;

(2) Provide for the monitoring of frequency usage and enforcement of frequency allocations;

(3) Identify agreements and procedures for coordinating use of radio frequencies with any launch site operator and any local and federal authorities, including the Federal Communications Commission; and

(4) Satisfy the requirements of any launch site operator's frequency management plan developed in compliance with part 420 of this chapter.

(h) *Security and hazard area surveillance plan.* An applicant's safety review document must contain a plan that defines the process for ensuring that any unauthorized persons, ships, trains, aircraft or other vehicles do not enter any hazard areas designated in accordance with the flight safety analysis or the ground safety analysis. The plan must describe how the launch operator will provide for day-of-flight surveillance of the flight hazard area established in accordance with § 417.225 of this chapter and ensure that the presence of any member of the public in or near a flight hazard area is consistent with flight commit criteria developed for each launch in accordance with § 417.113 of this chapter. This plan must identify the number of security and surveillance personnel employed for each launch and the qualifications and training each must have. This plan must identify the location of roadblocks and other security checkpoints, the times that each station must be manned, and any surveillance equipment used. This plan must contain, or incorporate by reference, all procedures for launch personnel control, handling of intruders, communications and coordination with launch personnel and other launch support entities, and implementation of any agreements with local authorities and any launch site operator.

(i) *Public coordination plan.* An applicant's safety review document must contain a plan that describes the processes for coordinating launch processing and flight with the local population and local government officials to ensure public safety. A public coordination plan must include the following:

(1) Procedures for implementing any launch-related agreements with local authorities;

(2) A schedule and procedures for the release of launch information prior to flight, post flight, and in the event of an anomaly;

(3) Procedures for public access to any launch viewing areas that are under the applicant's control; and

(4) A description of the interfaces established between launch personnel who implement the plan and any local authorities.

(j) *Local agreements and plans.* An applicant's safety review document must contain any agreements and plans with local authorities at or near a launch site whose support is needed to ensure public safety during all launch processing and flight activities. An applicant's local agreements and plans must satisfy any launch site operator's local agreements and plans developed in accordance with part 420 of this chapter. Local agreements and plans must include coordination with the following where applicable:

(1) Launch site operator;

(2) United States Coast Guard;

(3) FAA Air Traffic Control (ATC); and

(4) Any other local agency that supports the launch, such as local law enforcement agencies, emergency response agencies, fire departments, National Park Service, and Mineral Management Service.

(k) *Test plans.* An applicant's safety review document must contain a plan for the testing of each flight and ground system or equipment that provides public protection from adverse effects of launch processing and flight. Specific requirements applicable to testing of a flight safety system are provided in § 415.129 and subpart D of part 417 of this chapter. Each test plan must:

(1) Identify personnel who conduct the tests, and include a test schedule that indicates when specific tests are to be performed referenced to liftoff ;

(2) Identify the pass/fail criteria for each system or piece of equipment to be used for a launch;

(3) Contain, or incorporate by reference, test procedures for each system or piece of equipment to be used for a launch.

(l) *Countdown plan.* An applicant's safety review document must contain a countdown plan that describes the personnel and equipment that must be in place, the conditions that must be met, and the timed sequence of events that must take place to initiate flight of a launch vehicle while ensuring public safety. A countdown plan must:

(1) Cover the period of time when launch support personnel are to be at their designated stations through initiation of flight. (The period of time that a countdown plan covers may vary with launch vehicle configuration, the complexity of the supporting infrastructure, and complexity of vehicle processing leading to a flight attempt);

(2) Include procedures for handling anomalies that occur during a countdown and events and conditions that may result in a constraint to initiation of flight;

(3) Include procedures for delaying or holding a launch when necessary to allow for corrective actions, to await improved conditions, or to accommodate a launch wait;

(4) Describe a process for resolving issues that arise during a countdown and identify each person responsible for approving corrective actions; and

(5) Include a written countdown checklist that provides a formal decision process leading to flight initiation. A